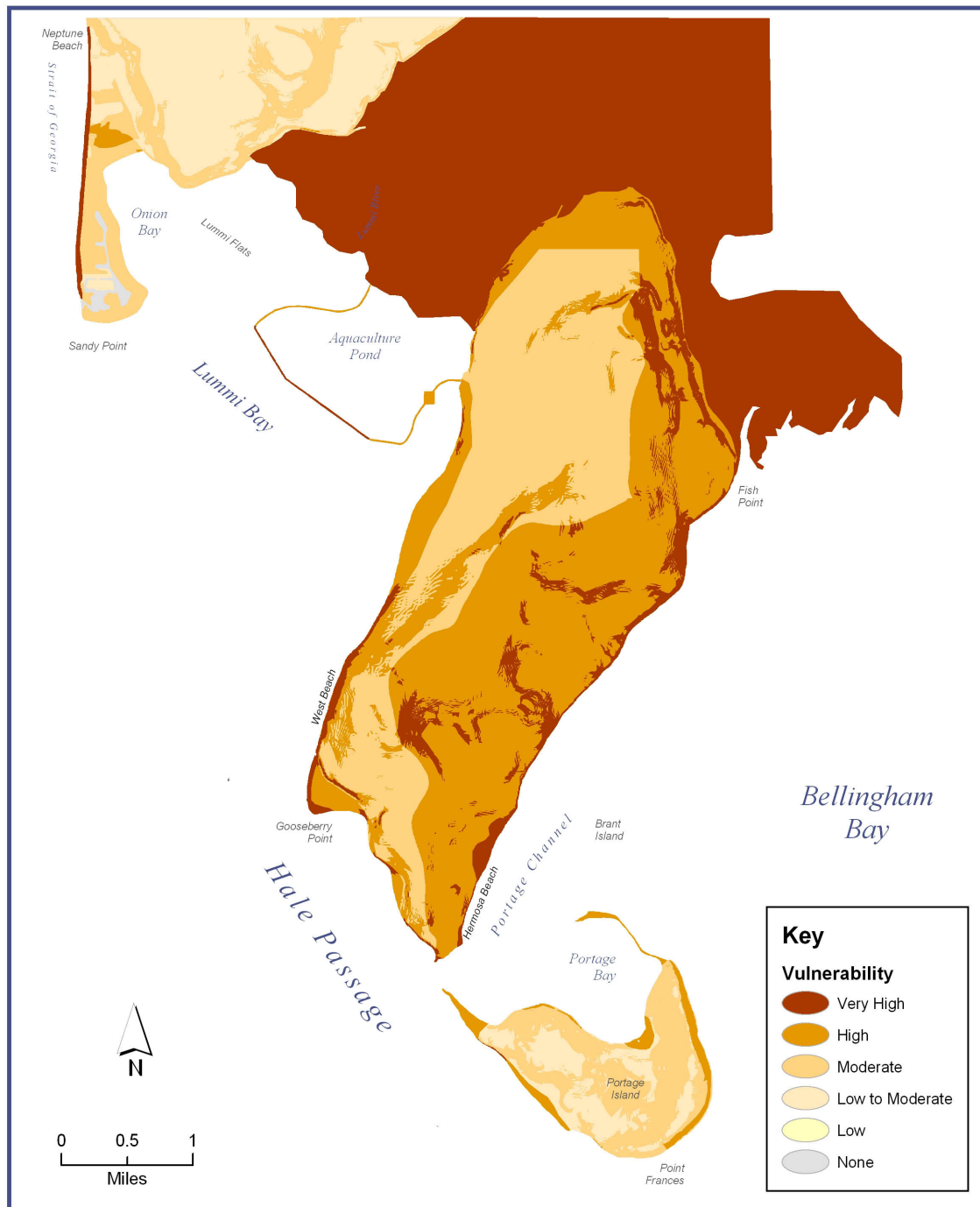


LUMMI NATION MULTI-HAZARD MITIGATION PLAN



Water Resources Division
Lummi Natural Resources Department

March 2004

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**LUMMI NATION
MULTI-HAZARD MITIGATION PLAN**

Prepared For:

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(LIBC)**

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Prepared By:

**Water Resources Division
Lummi Natural Resources Department**

Primary Author:

Steve Heywood

LIBC Water Resources Planner II

Primary Contributors:

**Jeremy Freimund, P.H.
Ann Stark
Andy Ross, LG, LHG**

**LIBC Water Resources Manager
LIBC GIS Coordinator
LIBC Water Resources Specialist**

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- Appendix B: Public PowerPoint Presentation on the Multi-Hazard Mitigation Plan
- Appendix C: Lummi Nation Emergency Management Response Interim Plan
- Appendix D: Lummi Nation Title 15A Flood Damage Prevention Code
- Appendix E: Summary of Lummi Nation Flood Policies

EXECUTIVE SUMMARY

The purpose of this Lummi Nation Multi-Hazard Mitigation Plan (MHMP) is to guide current and future efforts to effectively and efficiently mitigate natural hazards on the Lummi Indian Reservation (Reservation) and, in coordination with other jurisdictions as appropriate, to mitigate and respond to natural hazards that are generated off the Reservation or that cross the Reservation boundaries.

The Lummi Nation finds that natural hazards on the Reservation have a direct, serious, and substantial effect on the political integrity, economic security, health, and welfare of the Lummi Nation, its members, and all persons present on the Reservation. Further, the Lummi Nation finds that those activities that potentially increase the frequency or severity of damages from natural hazards, if left unregulated or unaddressed, will eventually cause such damages. Accordingly, the Lummi Natural Resources Department (LNR) and the Lummi Planning Department are developing the MHMP for the Reservation.

The goals of the Lummi Nation MHMP are to:

1. Reduce the threats to public health and safety posed by natural hazards;
2. Reduce structural damages caused by natural hazards;
3. Reduce the environmental impacts of natural hazards, mitigation actions, and future development activities; and
4. Reduce the long-term costs resulting from natural hazards and their mitigation.

The objectives of the MHMP are the following:

1. Prevent new development in areas that are vulnerable to hazards or ensure that development occurs in such a way that risk is minimized;
2. Protect or alter existing development in hazardous areas to make it less susceptible to damage;
3. Ensure that the solution chosen to protect existing development is the most cost-effective available; protects or enhances cultural resources, natural resources, and sensitive terrestrial, riparian, or coastal habitats; and is consistent with applicable land use plans and regulations;
4. Ensure that the benefits of maintaining existing facilities outweigh their costs; if not, redesign facilities to make them less susceptible to damage or implement some other type of solution at the site;
5. Redesign existing projects and/or change maintenance practices to protect or enhance riparian or coastal habitats;
6. Manage floodplains, rivers, streams, and other water resources for multiple uses, including flood- and erosion-hazard reduction, fish and wildlife habitat, finfish and shellfish harvesting, open space, recreation, water supply, cultural/traditional practices, and hydropower;
7. Improve coordination and consistency between the Lummi Nation and other jurisdictions, as appropriate, in management activities for floodplain and coastal areas;
8. Increase public awareness of natural hazards and improve appropriate preparation for and response to such hazards; and
9. Improve hazard warning and emergency response systems.

To reduce hazard damages and to achieve the MHMP goals and objectives, appropriate mitigation measures must be effectively applied. One such measure is the Land Use, Development, and Zoning Code, Title 15 of the Lummi Nation Code of Laws. Title 15 reduces hazards by ensuring that all proposed development activity on the Reservation is first reviewed for potential environmental impacts before it is authorized. The Lummi Nation Title 15A Flood Damage Prevention Code (FDPC) further addresses flood hazards on the Reservation and the Lummi Nation Coastal Zone Management Plan controls activities in the coastal zone. The Lummi Nation Building Code, Title 22 of the Lummi Nation Code of Laws, ensures that structures are constructed in a manner such that they will be safer for people during a disaster. These codes are administered by the Lummi Planning Department. To guide future land uses on the Reservation, the Planning Department is also developing a Comprehensive Plan. In addition, the Lummi Natural Resources Department administers the Water Resources Protection Code, Title 17 of the Lummi Nation Code of Laws, as part of its Comprehensive Water Resources Management Program (CWRMP). The CWRMP includes wellhead protection, storm water management, wetland management, nonpoint source pollution management, and water quality standards programs. The MHMP for the Reservation will support and complement these existing programs and activities and will promote continued involvement in off-Reservation, hazard mitigation-related activities.

Consistent with the Lummi Nation Flood Damage Reduction Plan adopted by the Lummi Indian Business Council (LIBC) in November 2001 and approved by the Federal Emergency Management Agency (FEMA) in January 2002, this MHMP recommends the following specific priorities for flood, tsunami, and volcanic lahar mitigation:

1. Protect the Nooksack and Lummi river floodplains on the Reservation and maintain access to the Lummi Peninsula by constructing a 100-year setback levee that extends along Ferndale Road from Ferndale to Kwina Slough, then along the north side of Kwina Slough to Marine Drive, and finally along Marine Drive to Lummi Shore Road (the levee should include a bridge over the Lummi River channel and box culverts or other structures to allow flow under Marine Drive);
2. Reduce the potential for flood damage along the low-lying coastal areas and concurrently reduce damage done to shoreline resources by bulkheads through the acquisition and removal or relocation of flood-prone structures currently located in the coastal velocity zones;
3. Raise Slater Road to the 100-year flood level both east and west of the Nooksack River and use bridges or similar structures to allow floodwaters to pass downstream;
4. Protect, acquire, or relocate vulnerable structures in the coastal and riverine floodplains, outside of the velocity zone and floodway, respectively; and
5. Provide access to the Lummi Peninsula in the case of levee failure along the Nooksack River by raising Haxton Way and providing for the flow of floodwaters under Haxton Way (this could serve as an interim measure prior to construction of a 100-year setback levee).

In addition, the following priorities are recommended for all natural hazards:

1. Establish emergency medical capability (an equipped Medic 1 unit along with paramedics and emergency medical technicians) located on the Reservation.
2. Promote the establishment and maintenance of home survival/emergency kits.
3. Pursue funding for the Lummi Nation mitigation priorities and recommendations described in this MHMP, including funding for needed staff and infrastructure.

4. Improve and sustain public education programs aimed at mitigating natural hazards.
5. Redirect and/or relocate development away from hazard areas.
6. Encourage seismic strength evaluations of schools, public infrastructure, and critical facilities on the Reservation to identify vulnerabilities and help prioritize mitigation to meet current seismic standards.
7. Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.
8. Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.
9. Continue monitoring of erosion rates along the shorelines of the Reservation.
10. Limit construction in identified landslide areas and encourage construction and subdivision design that can be applied to sloped areas to reduce development effects on landslide vulnerability.
11. Install tsunami warning and evacuation route signs in hazard areas and provide residents in the hazard areas with updated information on the tsunami hazard, including the probability of occurrence, potential size of the hazard, signs of an impending tsunami, and best route to avoid a tsunami.

This MHMP recommends the following action plan:

1. Establish and maintain a Multi-Hazard Mitigation Team composed of representatives from pertinent LIBC departments on the Reservation;
2. Pursue funding for the Lummi Nation mitigation priorities and recommendations described above, including funding for needed staff and infrastructure;
3. Approve a Comprehensive Plan that is aligned with the provisions of the Land Use, Development, and Zoning Code; the Flood Damage Prevention Code; the Building Code; the FDRP; the CZMP; the Water Resources Protection Code; other hazard-related ordinances; and the recommendations of this MHMP;
4. Coordinate hazard planning with other jurisdictions, as appropriate, and review any actions proposed for the Nooksack River and/or Lummi River watersheds that may affect flooding on the Reservation (i.e., all proposed actions);
5. Review and possibly amend the Flood Damage Prevention Code in response to an analysis of future-conditions flood levels and flood management actions implemented throughout the Nooksack River watershed;
6. Review potential participation in the Community Rating System and, if desirable and practicable, take appropriate actions to earn points toward discounts of flood insurance premiums for residents of the Reservation;
7. Continue to review hazard maps for accuracy and any changes in the estimated vulnerability of the Reservation;
8. Coordinate LIBC emergency response efforts with other appropriate jurisdictions and agencies; and
9. Implement a public education effort that will inform residents of the potential natural hazards on the Reservation.

Community involvement is an important element of the Lummi Nation MHMP because damage from natural hazards occurs across property and political boundaries and because community participation in developing and implementing the MHMP is necessary for the program to be successful. The three elements of the community involvement plan are (1) public education and outreach, (2) interjurisdictional coordination and cooperation, as appropriate, for activities off-Reservation that affect on-Reservation resources, and (3) working with project applicants to ensure compliance with Lummi Nation ordinances.

1. INTRODUCTION

The purpose of this Lummi Nation Multi-Hazard Mitigation Plan (MHMP) is to guide current and future efforts to effectively and efficiently mitigate natural hazards on the Lummi Indian Reservation (Reservation) and, in coordination with other agencies and jurisdictions as appropriate, to mitigate and respond to natural hazards that are generated off the Reservation or that cross the Reservation boundaries. This Lummi Nation MHMP establishes goals, lists objectives necessary to achieve the goals, and identifies policies, tools, and actions that will help meet the objectives. These short- and long-term actions will reduce the potential for losses on the Reservation due to natural hazards. In short, this plan is intended to help create a disaster-resistant Reservation by reducing the threat of natural hazards to life, property, emergency response capabilities, economic stability, and infrastructure, while encouraging the protection and restoration of natural and cultural resources.

The natural hazards that have affected the Reservation in the past and will affect the Reservation in the future include floods, earthquakes, severe winter storms, coastal erosion, windstorms, wildfires, drought, and landslides. In addition, volcanic activity from Mt. Baker and a tsunami (commonly called a "tidal wave") have a low probability of occurrence, but are potentially large hazards on the Reservation.

To protect the political integrity, economic security, health, and welfare of the Lummi Nation, its members, and all persons present on the Reservation, it is important for the Lummi Nation to minimize threats to public health and safety and damage to property from future hazard events. In developing a policy response, it is important to recognize that floods, earthquakes, severe winter storms, windstorms, wildfires, landslides, and other such events are naturally occurring processes that will present occasional disruption to the lives of Reservation residents. Any policy must also recognize that there are many private and public structures and facilities that have been constructed through time without regard to potential natural hazards. Fortunately, there are many things that can be done to reduce future risk and loss through on-the-ground structural and non-structural projects as well as regulatory actions.

This MHMP is one such action to reduce future risk and losses since it evaluates risks and identifies mitigation actions and also will qualify the Lummi Nation for funding under the Pre-Disaster Mitigation Program (PDM) that is administered by the Federal Emergency Management Agency (FEMA). This program provides funding for hazard mitigation planning and for mitigation projects that are implemented before a disaster. This plan may also help the Lummi Nation acquire funding under other programs, including the following:

- **Hazard Mitigation Grant Program**, which provides post-disaster funds for hazard reduction projects (e.g., elevation, relocation, or buyout of structures), administered by the Washington State Emergency Management Division (WEMD);
- **Flood Control Assistance Account Program**, which provides funds for developing flood hazard management plans, for flood damage reduction projects and studies, and for emergency flood-related projects (e.g., repair of levees); administered by the Washington State Department of Ecology (Ecology); and
- **Flood Mitigation Assistance Program**, which provides funds for flood mitigation on buildings that carry flood insurance and have been damaged by floods, administered by FEMA.

With this eligibility for grant programs, there is an opportunity to look to the future and work cooperatively and creatively to mitigate future damages and threats to public health and safety. This Multi-Hazard Mitigation Plan addresses the primary natural hazards that threaten the Reservation. Although many of the specific recommendations in the plan are directed at the Reservation, many will be most effective if implemented on a basin-wide basis. It is therefore intended that this plan provides solutions that other jurisdictions can use and benefit from and that can be cooperatively implemented.

Purpose/Goals

The goals of the Lummi Nation MHMP are to:

1. Reduce the threats to public health and safety posed by natural hazards;
2. Reduce structural damages caused by natural hazards;
3. Reduce the environmental impacts of natural hazards, mitigation actions, and future development activities; and
4. Reduce the long-term costs resulting from natural hazards and their mitigation.

Objectives

The objectives of the MHMP are the following:

1. Prevent new development in areas that are vulnerable to hazards or ensure that development occurs in such a way that risk is minimized;
2. Protect or alter existing development in hazardous areas to make it less susceptible to damage;
3. Ensure that the solution chosen to protect existing development is the most cost-effective available; protects or enhances cultural resources, natural resources, and sensitive terrestrial, riparian, or coastal habitats; and is consistent with applicable land use plans and regulations;
4. Ensure that the benefits of maintaining existing facilities outweigh their costs; if not, redesign facilities to make them less susceptible to damage or implement some other type of solution at the site;
5. Redesign existing projects and/or change maintenance practices to protect or enhance riparian or coastal habitats;
6. Manage floodplains, rivers, streams, and other water resources for multiple uses, including flood- and erosion-hazard reduction, fish and wildlife habitat, finfish and shellfish harvesting, open space, recreation, water supply, cultural/traditional practices, and hydropower;
7. Improve coordination and consistency between the Lummi Nation and other jurisdictions, as appropriate, in management activities for floodplain and coastal areas;
8. Increase public awareness of natural hazards and improve appropriate preparation for and response to such hazards; and
9. Improve hazard warning and emergency response systems.

To reduce hazard damages and to achieve the MHMP goals and objectives, appropriate mitigation measures must be effectively applied. One such measure is the Land Use, Development, and Zoning Code, Title 15 of the Lummi Nation Code of Laws. Title 15 reduces hazards by ensuring that all proposed development on the Reservation is first

evaluated for potential environmental impacts before it is authorized. The Lummi Nation Title 15A Flood Damage Prevention Code (FDPC) further addresses flood hazards on the Reservation, as does the Lummi Nation Flood Damage Reduction Plan (FDRP). The Lummi Nation Coastal Zone Management Plan controls activities in the coastal zone of the Reservation. The Lummi Nation Building Code, Title 22 of the Lummi Nation Code of Laws, ensures that structures are constructed in a manner such that they will be safer for people during a disaster. The Solid Waste Control and Disposal Code, Title 18 of the Lummi Nation Code of Laws, will reduce environmental damage caused by flood events. These codes are administered by the Lummi Planning Department. To guide future land uses on the Reservation, the Planning Department is also developing a Comprehensive Land Use Plan. In addition, the Lummi Natural Resources Department (LNR) administers the Water Resources Protection Code, Title 17 of the Lummi Nation Code of Laws, as part of its Comprehensive Water Resources Management Program (CWRMP). The CWRMP includes wellhead protection, storm water management, wetland management, nonpoint source pollution management, and water quality standards programs. All mitigation measures must also comply with the Cultural Resources Preservation Code, Title 40 of the Lummi Nation Code of Laws, which guides cultural resource management on the Reservation. This MHMP supports and complements these current on-Reservation programs and activities and also promotes continued involvement in appropriate off-Reservation activities related to hazard mitigation.

To improve preparation for future hazard events, the Lummi Indian Business Council (LIBC) is developing an Emergency Management Response Plan for the Lummi Nation (the draft plan is attached to this document in Appendix C). In addition, the Lummi Water Resources Division (LWRD) is developing a Spill Prevention and Response Plan to guide the response to spills of hazardous materials on and adjacent to the Reservation.

This MHMP provides detailed recommendations and an action plan designed to meet each objective and, ultimately, the goals of the plan. The Lummi Indian Business Council, the governing body of the Lummi Nation, passed Resolution No. 2004-015 (attached in Appendix A) on January 19, 2004, to formally adopt this plan.

This Lummi Nation MHMP is divided into eight sections:

- Section 1 is this introduction.
- Section 2 describes how the MHMP was prepared.
- Section 3 describes the land use, socioeconomic conditions, and physical characteristics of the Reservation.
- Section 4 presents an assessment of hazard risks on the Reservation.
- Section 5 presents the Lummi Nation mitigation strategy.
- Section 6 describes local mitigation planning coordination.
- Section 7 describes the MHMP maintenance process.
- Section 8 summarizes this report.

The references cited in this plan and the acronyms and abbreviations used in this plan follow Section 8.

2. PLANNING PROCESS

The current pre-disaster mitigation planning effort on the Lummi Reservation is intended to complement existing LIBC programs, including the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a). The MHMP is being developed pursuant to the requirements in the Interim Final Rule for hazard mitigation planning (44 Code of Federal Regulations [CFR], Parts 201 and 206, February 26, 2002) and the guidance in the State and Local Plan Interim Criteria Under the Disaster Mitigation Act of 2000 document (FEMA 2002a) and its associated plan review crosswalk.

The natural hazard mitigation planning process for the Lummi Nation began with a literature review conducted by LNR staff. The Whatcom County Hazard Identification and Vulnerability Analysis (Whatcom County 2002), developed by the Whatcom County Division of Emergency Management (DEM), and the Washington State Hazard Identification and Vulnerability Assessment (WEMD 2001), developed by the Washington State Emergency Management Division (WEMD), were also reviewed for information regarding the natural hazards present on the Reservation. The State of Oregon, Clackamas County, Kitsap County, City of Redmond, and Portland Metro hazard mitigation plans (Oregon 2000a; Clackamas County 2002; Kitsap County 1999; City of Redmond 2002; and Portland Metro 1999) were reviewed for information and mitigation alternatives pertinent to the natural hazards on the Reservation. The FEMA how-to guides on mitigation planning, *Getting Started: Building Support for Mitigation Planning* (FEMA 2002b), *Understanding Your Risks: Identifying Hazards and Estimating Losses* (FEMA 2001a), and *Developing the Mitigation Plan: Identifying Mitigation Actions and Implementation Strategies* (FEMA 2003a), were used to guide the planning process, to help assess hazard risks and vulnerabilities, and to develop this MHMP.

The Lower Nooksack River Comprehensive Flood Hazard Management Plan (CFHMP; Whatcom County 1997a, 1999) and flood plans from other jurisdictions were reviewed previously for information and mitigation alternatives pertinent to the flood hazards on the Reservation. The Revised Preliminary Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) for the Lummi Reservation (FEMA 2003b and 2003c) were used to identify the flood-prone areas on the Reservation. A small area of known flooding along Lummi Shore Road not identified on the FIRM was also considered to be flood-prone. The recorded flood history (Whatcom County 1995a) and newspaper articles on recent flood events (LWRD 2001a) were reviewed for information on past damages and hazards. Current and future flood hazards on the Reservation were determined by identifying currently developed properties and current land uses in the flood-prone areas and by reviewing land use zoning on the Reservation. Flood hazards in potential velocity zones were made a high priority for potential flood mitigation.

For other natural hazards, pertinent literature and websites were reviewed for current information on past hazard events and hazard vulnerability. In addition, staff of the WEMD provided a Hazards-U.S. (HAZUS) analysis of the estimated potential earthquake damage on the Reservation. Coastal Geologic Services, Inc., provided an assessment of coastal erosion vulnerability and information on landslide hazards on the Reservation.

This plan builds on the development of the Lummi Nation Flood Damage Reduction Ordinance (Title 15A), the Lummi Coastal Zone Management Plan, the Lummi Reservation Comprehensive Plan, and the CWRMP; past work by the Lummi Flood

Management Committee (inactive since 1997); involvement by the Lummi Nation in the planning process for the Lower Nooksack River Comprehensive Flood Hazard Management Plan (Whatcom County 1999), which is being developed by neighboring Whatcom County; and the development of the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a).

Natural hazard mitigation activities currently in place were identified and evaluated for their future effectiveness. This evaluation of the effectiveness of current mitigation was compared with the assessment of natural hazards to identify which hazards required additional mitigation measures. Short- and long-term mitigation alternatives for each hazard were identified, evaluated, and prioritized. These mitigation alternatives were then used to develop an action plan to address the primary natural hazards on the Reservation.

Public Participation Process

This MHMP was reviewed by staff of the Lummi Natural Resources Department, Lummi Planning Department, and Lummi Cultural Resource Management Program, as well as by the Lummi Chief of Police, LIBC Safety Officer, and LIBC Training Officer. A Microsoft PowerPoint slide presentation (attached in Appendix B) on the MHMP, including the proposed mitigation priorities and action plan, was developed and presented to members of the Lummi Natural Resources Commission and the LNR Executive Director and Environmental Director. Based on comments received, a revised 45-minute presentation was presented to the Lummi Natural Resources Commission, Lummi Planning Commission, Lummi Law and Justice Commission, and staff of the LIBC Cultural Resource Management Program. These groups received the MHMP Executive Summary, a list of the proposed mitigation measures in the MHMP, and the proposed MHMP action plan for review before the PowerPoint presentation. The comments received during this review process were incorporated into this final MHMP document.

Based on this review process, the Lummi Natural Resources Commission, Lummi Planning Commission, Lummi Law and Justice Commission, Lummi Natural Resources Commission Chairman, LNR Executive Director, and Lummi Planning Department Director all recommended that the LIBC adopt the MHMP. The MHMP, the MHMP Executive Summary, a list of the proposed mitigation measures, the proposed MHMP action plan, and a resolution adopting the MHMP were then presented to the LIBC for review. The LIBC, the governing body of the Lummi Nation, passed Resolution No. 2004-015 (attached in Appendix A) on January 19, 2004, to formally adopt this MHMP.

3. DESCRIPTION OF THE LUMMI RESERVATION

The Lummi Indian Reservation is located approximately eight miles west of Bellingham, Washington, 90 miles north of Seattle, Washington, and 60 miles south of Vancouver, British Columbia, Canada.

The Reservation is located at the mouth of the Nooksack River and along the western border of Whatcom County, Washington (Figure 3.1). The Nooksack River drains a watershed of 786 square miles, flows through the Reservation near the mouth of the river, and discharges to Bellingham Bay (and partially to Lummi Bay during high flows). The Reservation is located at the southern extent of Georgia Strait and the northern extent of Puget Sound. Approximately 38 miles of highly productive marine shoreline surround the Reservation on all but the north and northeast borders. Much of the high density development to date has occurred along the marine shoreline. The Reservation includes the Nooksack and Lummi river deltas, tidelands, and forested uplands. The Reservation also features relatively low topographic relief and a temperate marine climate.

The land uses, topography, climate, hydrogeology, soils, watersheds, and surface water resources on the Reservation affect the vulnerability of the Reservation to natural hazards. This section briefly describes each of these elements. More detailed descriptions can be found in the following reports: Lummi Nation Wellhead Protection Program -- Phase I (LWRD 1997); Lummi Reservation Storm Water Management Program Technical Background Document (LWRD 1998); Lummi Indian Reservation Wetland Management Program Technical Background Document (LWRD 2000); and the Lummi Nation Nonpoint Source Assessment Report (LWRD 2001b).

3.1 LAND USE, PUBLIC SERVICES, AND SOCIOECONOMIC CONDITIONS

Like most places, land use changes on the Reservation have generally been associated with changes in vegetation types, decreases in the areas covered by vegetation, changes in natural drainage patterns, and increases in impervious surfaces. After their arrival, Euro-Americans logged, cleared, and drained forested land for agricultural, residential, and commercial development. Natural drainage patterns on the Reservation were substantially altered by the road system, agricultural drainage ditches, and dikes.

Historic, current, and projected future land uses in the Reservation watersheds and socioeconomic conditions on the Reservation are described below. Much of the information about historic land uses and socioeconomic conditions comes from the *Lummi Nation Comprehensive Environmental Land Use Plan: Background Document* (LIBC 1996).

3.1.1 Historic Land Use

Before the arrival of Euro-Americans, the Lummi people were a fishing, hunting, and gathering society. Based on the accounts of Lummi Elders, early European explorers, and early photographs of the region, before 1850 old-growth forests of massive Douglas fir, western hemlock, spruce, and western red cedar dominated what was to become the Lummi Reservation. Deciduous trees such as western big leaf maple, black cottonwood, red alder, and western paper birch were also likely present along the rivers, streams, and open areas. Understory vegetation probably included vine maple, Oregon grape,

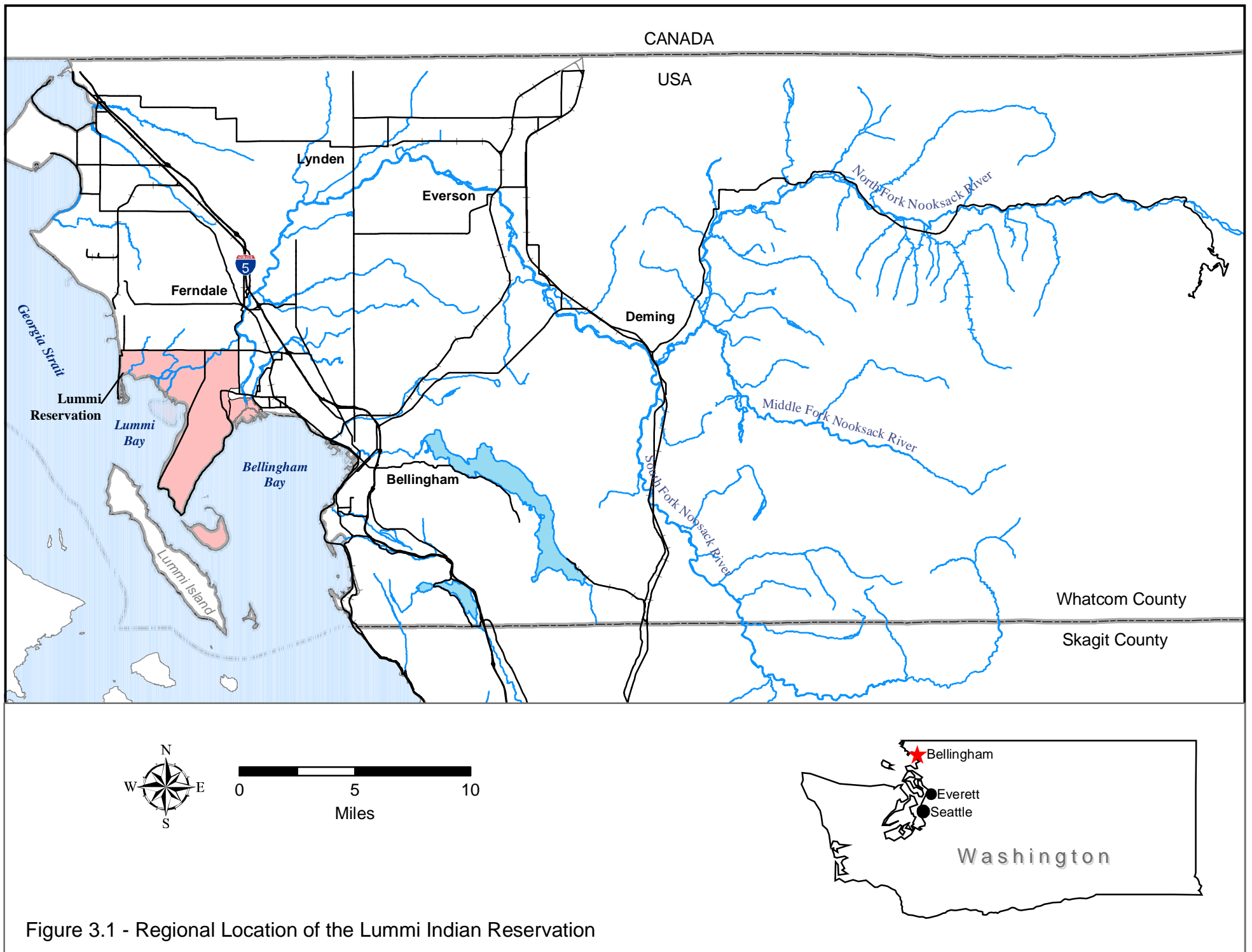


Figure 3.1 - Regional Location of the Lummi Indian Reservation

several different willows, ocean spray, salmon berry, thimbleberry, soapberry, and many others. Wetlands, streams, and rivers supported a unique array of plants adapted to wet environments. The marine shoreline was also a unique environment, where only plants adapted to a saltwater-influenced environment thrived.

The forces that shaped vegetation patterns in the Northwest before the arrival of Euro-Americans were forest succession, fires, windstorms, ice storms, floods, and traditional use of natural vegetation by the indigenous peoples. Native American uses of vegetation included the gathering of medicinal plants, the use of willows and other shrubs for fishing, and the extensive use of western red cedar trees for many things, including clothing, baskets, buildings, and canoes. Many plants were also sources of food to complement the traditional diet of fish, shellfish, elk, and deer. Native Americans cultivated some of these plants, such as ferns, camas, and wapato, in prairies along the Nooksack River.

Similar to most areas in the lower Nooksack River watershed downstream from Everson, conversion of forestland to agricultural land occurred on the Lummi Reservation following the arrival of Euro-Americans. In 1896, approximately 1,222 acres were reportedly under cultivation on the Reservation. Along with clearing the forested land for agriculture, Euro-Americans constructed ditches, drained wetland areas, cleared logjams, diverted the Nooksack River to drain into Bellingham Bay, built a levee that cut off the Lummi River delta from the Nooksack River, and built a seawall along Lummi Bay. These changes in the natural hydrology of the Lummi Reservation changed the distribution and patterns of watercourses and of wetland- and riparian-associated plant communities. Figure 3.7 shows the extent of the agricultural drainage network on the Reservation in the Lummi and Nooksack river floodplain.

Much of the cedar on the Reservation was cut into shingle bolts and shipped to local shingle mills. The old-growth trees on Portage Island were cut down to fuel steamboats traveling the Nooksack River. One or more large fires swept through the Reservation area between 1850 and 1900. These fires destroyed nearly all of the remaining old-growth forests. Since reforestation was not practiced during the early logging period and did not begin until approximately 1980, pioneer tree species, such as alder, willows, and cottonwoods, soon replaced the conifer forests and dominated the landscape (Leckman 1990). Although there are some conifer groves and Douglas fir plantations, the 2003 inventory of Reservation forests showed that present day forests on the Reservation are largely comprised of deciduous trees, with some mixed deciduous/conifer stands (Tweedie and Holter 2002; International Forestry Consultants, Inc., 2003; see Figure 3.3).

Historically, the Nooksack River flowed (alternately or simultaneously) to both Lummi and Bellingham bays (effectively making the Lummi Peninsula an “island”). Before 1860, the Nooksack River discharged primarily into Lummi Bay by way of the present Lummi River channel, with smaller distributaries flowing into Bellingham Bay (WSDC 1960; Deardorff 1992). In 1860 a logjam blocked the Nooksack River near present-day Ferndale and diverted it to a small stream that flowed into Bellingham Bay (WSDC 1960). Since that time, considerable effort has been expended to keep the Nooksack River discharging into Bellingham Bay because of the increased commercial value of the river that resulted from its proximity to sawmills along Bellingham Bay (Deardorff 1992). Until the early 1900s, the Nooksack River was also the primary transportation corridor for Ferndale, Deming, and Lynden residents to travel to Bellingham. The stream

remaining in the old channel of the Nooksack River has been called the Lummi River or the Red River (WSDC 1960).

In the 1920s, a reclamation project was initiated both to construct a dike/seawall to keep back the sea along the shore of Lummi Bay and to construct a levee along the west side of the Nooksack River (Deardorff 1992). This project, which was started in 1926 and completed in 1934, initially resulted in the nearly complete separation of the Lummi River from the Nooksack River. However, when saltwater intrusion onto the newly reclaimed farmlands and damage to the dam at the head of the Lummi River occurred during flooding, the dam was replaced with a dam and spillway structure (Deardorff 1992). This spillway structure was also damaged over the years during high-flow conditions and was replaced in 1951 by a five-foot-diameter culvert (FEMA 2003c) that allowed flow from the Nooksack River into the Lummi River. Currently a four-foot culvert (Deardorff 1992) allows flow to the Lummi River only during relatively high-flow conditions (approximately 10,000 cfs). Levees were also constructed along the Lummi River to prevent saltwater from Lummi Bay from flowing onto adjacent farmlands during higher tides.

The dike and levee construction activities were accompanied by agricultural ditching to drain fields and wetland areas. Based on 1887-88 topographic surveys, Bortleson et al. (1980) estimated that wetlands located landward of the general saltwater shoreline in the lower Lummi River watershed have decreased from approximately 2.0 square miles (mi^2) to 0.1 mi^2 (approximately 95 percent) over the 1888-1973 period.

3.1.2 Current Land Use

As part of the Storm Water Management Program (SWMP) study (LWRD 1998), a LANDSAT satellite image from August 15, 1991, was used to estimate the extent of various land uses in the watersheds that drain to the Reservation tidelands. The Whatcom County Planning and Development Services had classified the image into different land cover types (Whatcom County is adjacent to the Reservation). The land uses in the Nooksack River basin were characterized based on information presented in the Whatcom County Comprehensive Plan (Whatcom County 1997b).

The focus of the LANDSAT image classification effort by Whatcom County was to analyze forest cover types and structure in the foothills of Whatcom County (rather than to analyze the lowlands). Urban and agricultural classifications were not field-validated to the extent of the forest cover types. Consequently, classification errors for these two cover types are apparent in the map of land cover types shown in Figure 3.2. For example, locations known to be agricultural fields were sometimes classified as urban/residential areas. Locations that had been incorrectly classified as urban/residential/industrial were generally attributed to grasses/agriculture land use, except for Portage Island. On Portage Island, this classification was interpreted to be rocks in the beach areas.

Wetland areas were not a separate land cover classification in the satellite image, but were added to the list of land covers by LNR during the SWMP study (LWRD 1998). Using wetland information derived from existing geographic information system (GIS) coverages of wetland locations, the initial extent of land cover types estimated from the LANDSAT image were adjusted (LWRD 1998) to reflect the presence of wetlands. The GIS coverages of wetland locations used in this 1997-1998 analysis were derived from

the National Wetland Inventory maps (USFWS 1987) and from wetland location maps developed by a tribal consultant (Arnett 1994).

The estimated distribution of land-cover/land-use types on the Lummi Reservation is summarized in Table 3.1, and the locations of the various land cover types are shown in Figure 3.2. As evident in Table 3.1, which excludes both the tribal tidelands and the land-cover/land-use types in the Nooksack River watershed outside the Reservation, approximately 91 percent of the Reservation lands are either agricultural, forested, or wetlands. A comprehensive inventory of Reservation wetlands conducted in 1999 (Harper 1999; LWRD 2000a) found that portions of the grass/agricultural and forest areas listed in Table 3.1 are also wetlands. The percentages in Table 3.1 do not reflect the 1999 inventory information. Figures 3.2, 3.3, and 3.9 show that much of the floodplain on the Reservation consists of grasses/agricultural land and is also classified as wetland or wetland complexes.

Table 3.1 Current land-cover/land-use types on the Lummi Reservation¹

Land Cover/Land Use	Percent of Area¹
Grasses/Agricultural	51.55
Deciduous Forest	25.13
Wetlands	9.79
Coniferous and Mixed Forest	4.60
Scrub-Shrub	2.87
Residential/Urban/Industrial	2.75
Fallow Fields/Exposed Soil	2.07
Water	1.20
Rock	0.04

¹ Does not include the Nooksack River watershed (off-Reservation) or tribal tidelands

Figure 3.3 presents an analysis of land use/land cover on the Reservation that is more specific than that of Figure 3.2. Figure 3.3 was derived from interpretation of aerial color photos taken in 1983; this interpretation was updated with information from black and white aerial photos taken in 1991 (Caplow 1993). Information from National Wetland Inventory maps (USFWS 1987) was also used to identify wetlands. The predominance of agriculture in the floodplain that is depicted in Figure 3.3 has not changed to this date, though a gas station/mini-mart and a casino are currently located at the southeast corner of Haxton Way and Slater Road. Because tree harvests have been very limited since 1990, the distribution of forests seen in Figure 3.3 is a relatively accurate depiction of the current composition of Reservation forests (Tweedie and Holter 2002). Moderate clearing for development has occurred since 1991, including areas for the Wex li em community building, Mackenzie housing development, and the new tribal school. Figure 3.3 also provides a clear indication of the extensive development of the low-lying Sandy Point, Gooseberry Point, and (to a lesser degree) Hermosa Beach shorelines and of the presence of wetlands on the Sandy Point Peninsula.

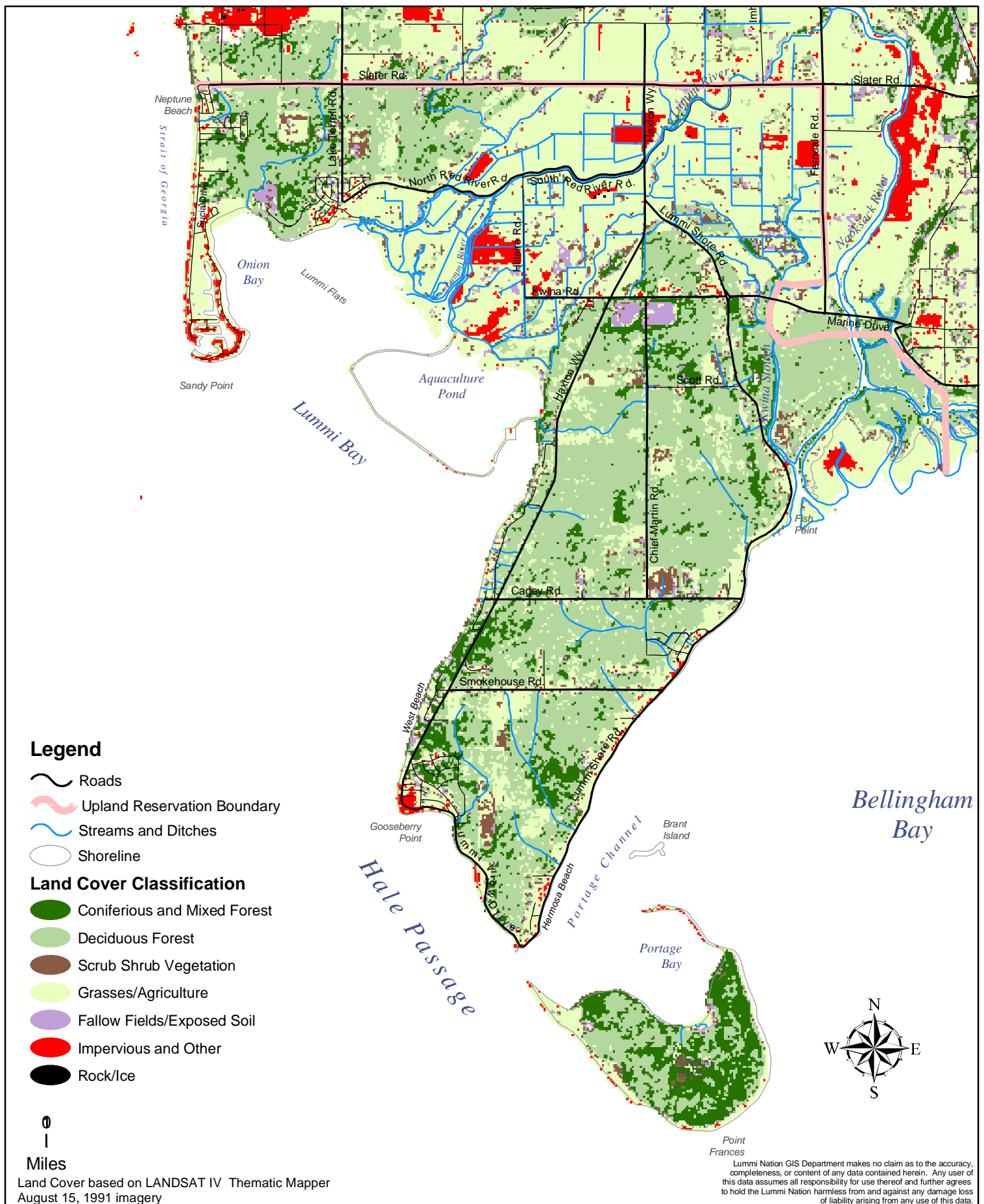


Figure 3.2 Land Cover Types of the Lummi Reservation and Environs



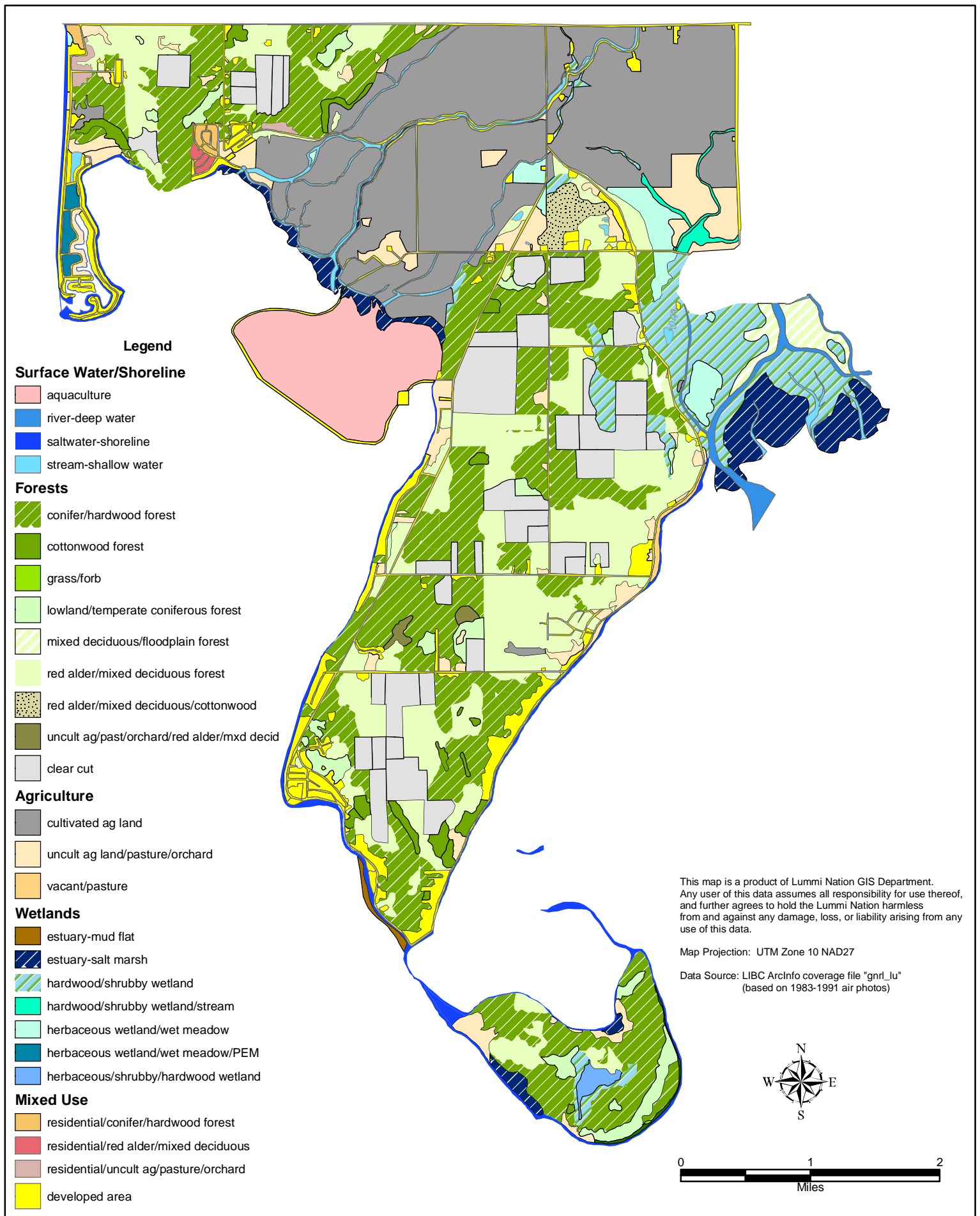


Figure 3.3 Upland Use/Land Cover on the Lummi Reservation

Based on estimates of land cover in Whatcom County (Whatcom County 1997b), land cover/use in the Nooksack River watershed is currently generally dominated by forested areas upstream from the town of Deming and agricultural lands downstream from Deming. The agricultural lands in the lowlands were largely forested before the arrival of Euro-Americans and had been largely denuded of trees by 1925 (Pierson 1953, as cited in Smelser 1970). Population centers such as Ferndale, Lynden, Everson, and Deming are located adjacent to the Nooksack River.

The 2000 Census found 1,749 housing units on the Reservation, of which 1,455 (83.2%) were occupied year-round and 221 (12.6%) were for seasonal or occasional use. The remaining 73 (4.2%) housing units were vacant. Many of the more expensive homes on the Reservation are located in the coastal flood zones along the Sandy Point Peninsula, Neptune Beach, Gooseberry Point, and Hermosa Beach shorelines. Most of these houses were constructed since 1960, including significant new construction and additions in the past two decades. Relatively few homes are located in the Nooksack River floodplain; many of these are on agricultural properties and were constructed before 1950. Figures 3.4 and 3.5 show the distribution of households in 1950 and in 1995. The total population of the Reservation was 4,193 in the 2000 Census, a dramatic increase from 721 in the 1960 census. In the 2000 census, 2,240 people identified themselves as American Indian alone or in combination with other races (53.4 percent of the total Reservation population). Corrected for the estimated rate of undercount (4.74 percent), the estimated actual American Indian population on the Reservation was 2,346 in the year 2000 (Northwest Economic Associates 2003).

3.1.3 Future Land Use

A recent study projected that the number of American Indians living on the Reservation will increase from 2,346 in 2000 to 3,767 in 2020 and to 15,451 in 2100 (Northwest Economic Associates 2003). The study cited above predicted that the Indian population on the Reservation will grow at a faster rate than the non-Indian population. Hence, the non-Indian population, 1,953 in the 2000 census, will likely be between 2,000 and 3,000 in 2020, and the total Reservation population will likely be between 5,800 and 6,800 in the year 2020 (based on the 2000 Census data and the projections in the Northwest Economic Associates study). These population projections, planned economic and institutional growth on the Reservation, and the small percentage of tribal land that has been developed suggest that portions of presently forested or agricultural lands on the Reservation will be converted to residential, commercial, municipal, and/or industrial uses in the coming years.

Similarly, future land use in the Nooksack River watershed is projected to include more residential, commercial, municipal, and industrial development to accommodate projected population increases (Whatcom County 1997b).

Future development will be guided by the Lummi Nation Title 15 Land Use, Development, and Zoning Code (LZC, first enacted January 5, 1968; last amended January 19, 2004) and the Title 15A Flood Damage Prevention Code (FDPC, adopted July 22, 1997). Construction is regulated by the Lummi Nation Title 22 Building Code (enacted January 5, 1968; last amended January 19, 2004), which adopted the Uniform Building Code. The Zoning and Building codes were recently amended to ensure consistency with current development standards, water protection policies, and building

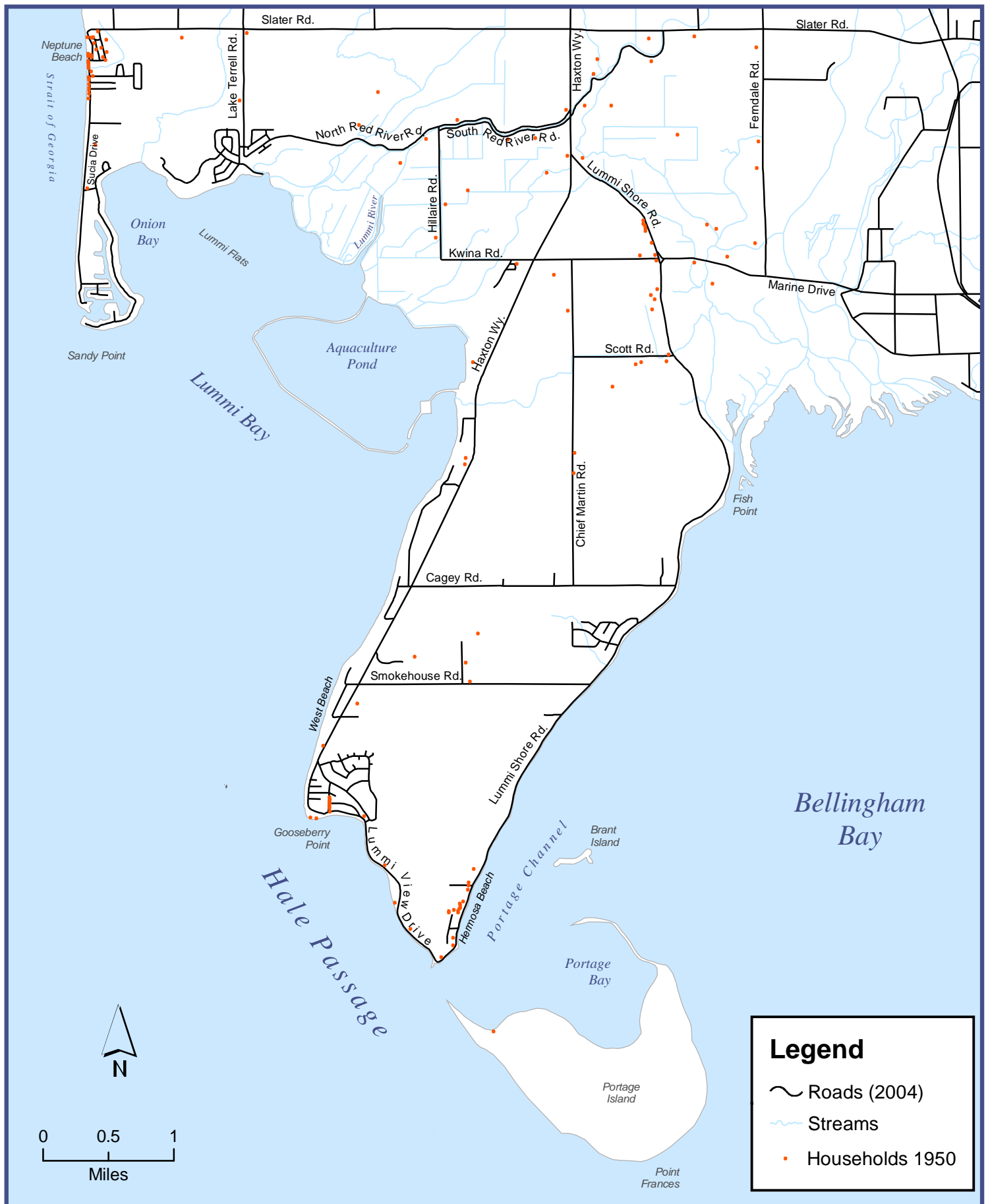


Figure 3.4 Households on the Lummi Reservation, 1950

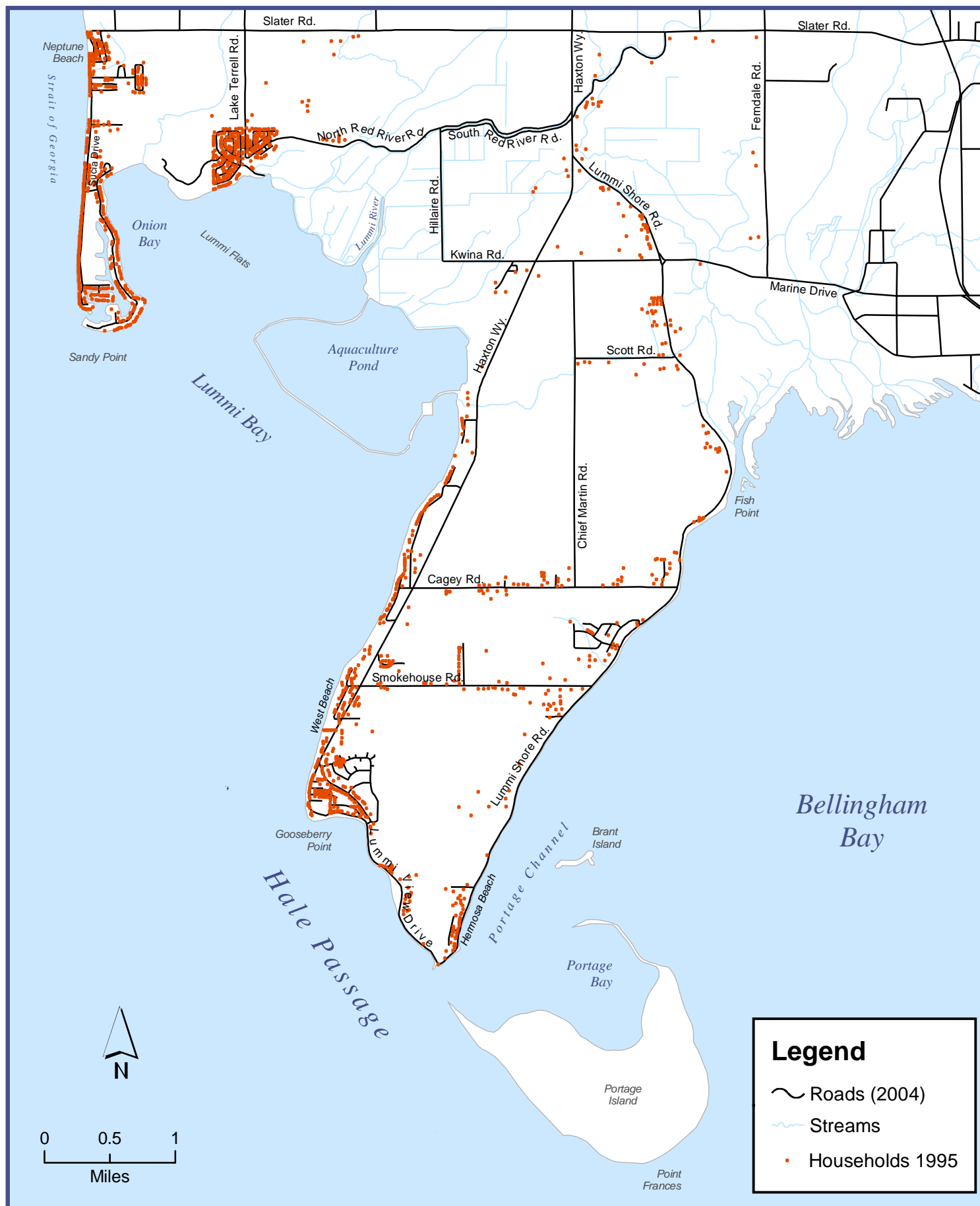


Figure 3.5 Households on the Lummi Reservation, 1995

designs. These three codes are administered by the Lummi Planning Department and enforced by the Lummi Planning Commission. These codes will limit and regulate development on the Reservation, including in the Special Flood Hazard Areas identified on the Flood Insurance Rate Map (FIRM) for the Reservation. The Lummi Coastal Zone Management Plan and the CWRMP will also guide development on the Reservation.

Figure 3.6 shows the current official zoning map of the Lummi Nation. This zoning map is being amended as part of the comprehensive planning effort currently underway by the Planning Department. In general, the proposed amendments to the zoning map will decrease the land base that is zoned for forestry and increase the land area zoned for residential, commercial, mixed use, and industrial land uses. The amendments to the official zoning map are expected to be completed during 2004.

The Lummi Planning Department is developing a Comprehensive Plan for the Lummi Reservation. The plan will show, in general, how land on the Reservation will be used over the next 20 years. The Comprehensive Plan will identify areas that will be developed for residential, commercial, mixed uses, industrial, and agricultural purposes, as well as showing areas that require protection (e.g., Special Flood Hazard Areas, wetlands, and aquifer recharge zones). To date, a technical background document (LIBC 1996) has been developed, public opinion surveys conducted, drafts of the Comprehensive Plan and maps developed, and focused planning workshops and meetings with commissions and community groups have occurred. The Comprehensive Plan is codified in the Lummi Nation Title 15 Land Use, Development, and Zoning Code. The revised zoning code also formalizes an environmental review process that was already largely in place pursuant to LIBC resolutions. The Comprehensive Plan, the revised zoning code, and the review process will reduce hazard damages by ensuring that land use is compatible with the landscape, that infrastructure is developed in a coordinated fashion, and that development has the overall effect of minimizing land-disturbing activities.

3.1.4 Utilities

The Lummi Water District is the largest and most comprehensive water system on the Reservation. It relies primarily on Reservation ground water from public supply wells, supplemented as necessary by water purchased under contract from the City of Bellingham. Seven small water systems operated by private, non-Indian water associations provide predominantly non-Indian residential areas with ground water that is withdrawn from Reservation aquifers pursuant to Washington State water rights permits. The Lummi Nation's reserved water rights pre-date and are superior to any permits or water rights acquired from the state. A number of domestic wells belonging to individuals and small groups also supply residences under both tribal and state-claimed authority (LIBC 1996). A federal lawsuit intended to resolve conflicts over competing claims to use the limited Reservation water resources is currently underway (*United States and Lummi Nation vs. Washington State Department of Ecology, et al.*, Civil Action No. C01-0047Z [U.S. District Court, Western District of Washington]).

The Lummi Sewer District operates a comprehensive, Reservation-wide, wastewater collection and treatment system that serves the majority of households on the Reservation. The sewer facilities consist of sewer collectors, sewer interceptors, 26 pump stations, and two treatment plants (LIBC 1996). For residences not on a sewer

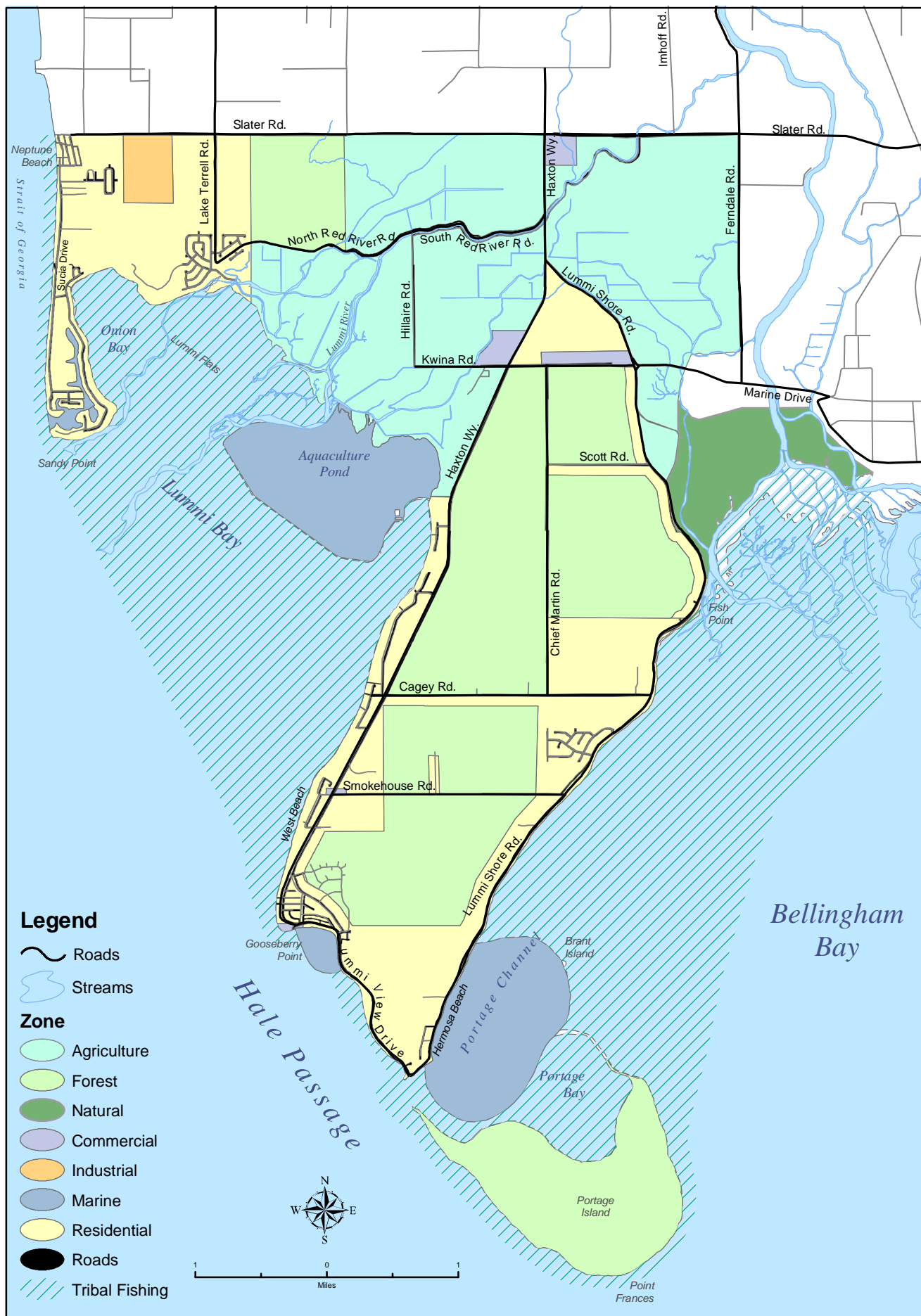


Figure 3.6 Current Land Use Zones on the Lummi Reservation

line, the Lummi Nation Title 16 Sewer Code regulates sewage disposal for public health and safety and establishes criteria for the design, construction, alteration, and operation of on-site septic systems. The Lummi Sewer District enforces the sewer code and inspects on-site septic systems. The Sewer Code serves to minimize pollution during flood events by ensuring that appropriate sanitary sewer facilities are used by Reservation residents and that systems are operated and maintained in a manner that protects public health.

Six of the sewer pump stations are within the Lummi and Nooksack river floodplains and eight are located in areas susceptible to coastal flooding events. These pump stations have been flood-proofed to minimize their susceptibility to flood damage. Although some water and sewer lines cross the Nooksack River floodplain or the coastal flood areas, both wastewater treatment plants and all public water supply wells are outside of flood-prone areas. However, some hydraulic loading of wastewater facilities can occur during floods because of floodwater seepage into manholes in the floodplain.

Collection services for solid waste and recyclable materials are offered to the residents and businesses of the Reservation by a private company (Sanitary Services Corporation). Electricity is delivered to the Reservation by Puget Sound Energy. Natural gas is currently available only to the northern part of the Reservation (Silver Reef Casino), but may become more widely available in the future. Telephone service is currently provided by Verizon and Qwest.

3.1.5 Emergency Services

Three fire districts with primarily volunteer staff provide fire protection and medical aid services on the Reservation. Whatcom County Fire District 8 covers the Reservation south of the Lummi River, including the Lummi Peninsula. The main District 8 station (No. 1) is located on Bennett Avenue on the outskirts of Bellingham, with an approximate response time of 10-12 minutes to the Kwina Road area (tribal offices, tribal schools, and Northwest Indian College). It has four full-time career firefighters, including the district fire chief, during the day and a sleeper shift of volunteers at night. District 8 Station No. 5 is located at Gooseberry Point and has a resident program of five live-in volunteers who are assigned to shifts, but the station is not manned at all times. Both of these stations have a medical aid vehicle. District 8 Station No. 3 on Curtis Road (east of the Nooksack River) has no volunteer responders and is currently only used to store vehicles (Crawford 2003).

Whatcom County Fire District 17 provides fire protection and medical aid services to the Sandy Point Peninsula and Sandy Point Heights/Lake Terrell Road areas in the northwest portion of the Reservation. District 17 has two stations, one on the Sandy Point Peninsula (Station No. 1 at 4332 Sucia Drive) and one at Sandy Point Heights (Station No. 2 on 3685 Prevost Way). Both stations are unmanned, with volunteers providing all response to emergency calls. Only Station No. 1 has an aid vehicle (Peterson 2003). Station No. 1 lies within the coastal shallow flooding zone and has had to be protected by sand bags during recent coastal flooding. Fire Districts 8 and 17 are supported by revenues from property taxes, payments in lieu of taxes by the Bureau of Land Management, and direct contributions from the Lummi Nation. The LIBC provided an aid car to each district in 1992 (LIBC 1996).

Whatcom County Fire District No. 7, with its main station in Ferndale, approximately two miles north of the Reservation, provides fire protection and medical aid services to the Slater Road area along the northern boundary of the Reservation, including the Silver Reef Casino and the Shell gas station. The Ferndale station has three full-time career firefighters as well as volunteer responders. The station is manned 24 hours a day. In 2003, the LIBC provided a community contribution of \$21,000 to District No. 7 that was used to replace aging equipment.

The Lummi Law and Order Department provides public safety protection throughout the Reservation and works with the Federal Bureau of Investigation (FBI), the Whatcom County Sheriff's Department, and other agencies. Lummi Law and Order has jurisdiction over all members of federally recognized tribes on the Reservation. The Whatcom County Sheriff's Department has jurisdiction when an offense is committed on the Reservation by a person who is not a member of a federally recognized tribe or if the offense is committed on fee land. The FBI investigates major crimes that are committed on trust land by members of federally recognized tribes. The Law and Order Department is responsible for enforcement of the Lummi Nation Code of Laws. It employs 14 officers, including a chief administrator, one lieutenant, two sergeants, a juvenile officer, and one investigator. All members of the force are certified by the State of Washington and the Bureau of Indian Affairs (BIA). The force has six marked patrol cars, two detective cars, and two administrative vehicles. The Lummi Law and Order Department is the first responder to all emergency calls on the Reservation and is responsible for emergency services on the Reservation in the case of flood, earthquake, or other natural disasters.

Lummi Law and Order, in cooperation with the Whatcom County Division of Emergency Management (in the county Sheriff's Department) and local fire and police agencies, is trained and prepared to respond to minor spills or releases of some hazardous materials. Small quantities of hazardous materials are known to be used and transported through the Reservation on a regular basis. The most significant operations using hazardous materials are the two oil refineries and one aluminum smelter located just north of the Reservation. One of the main transportation routes to and from these operations is Slater Road, which follows the northern boundary of the Reservation. In response to a major hazardous material spill on the Reservation, experts from the U.S. Environmental Protection Agency (EPA) and local industries would be called in to help control the damage. A draft integrated Spill Prevention and Response Plan being developed by the Lummi Water Resources Division (LWRD) will further describe the emergency response capabilities of these agencies.

3.1.6 Socioeconomic Conditions

Fishing, logging, farming, and other natural resource work has historically provided most of the jobs for Lummi tribal members. Until the 1974 Boldt Decision, Lummi tribal members were systematically precluded from the profitable salmon fishery in Puget Sound. Once the treaty fishing right was upheld by the U. S. Supreme Court, commercial fishing and fish processing began to expand on the Reservation, with increasing numbers of fishermen, fish processing, and increased overall tribal revenue from salmon fisheries. The Lummi Nation is currently the largest fishing tribe in Puget Sound. However, the recent declines in salmon stocks have dramatically altered the tribal dependence on salmon fishing as an economic mainstay. In 1985, the average Lummi fisherman made \$22,796. In 1993, the average income from fishing was only

\$5,555. During this period, about 30 percent of the tribal work force relied on fishing for their sole source of income. Since 1993, further reductions in salmon stocks have resulted in closure of some fisheries and a further reduction in tribal fishery incomes (LIBC 1996). In recent years, the annual value of the Lummi Nation fishery has declined from a high of over \$13 million in 1985 to approximately \$3 million in 1999.

In addition to catching finfish and harvesting shellfish, the Lummi Nation owns and operates three fish hatchery facilities. These facilities produce millions of young salmon each year and help offset the decline of fish stocks due to loss of natural habitat and historic over-fishing. The tribe also owns an on-Reservation shellfish hatchery, producing over one billion oyster and clam seeds annually. The Lummi Reservation includes approximately 7,000 acres of tidelands, much of which is suitable for productive shellfish beds. All of these tidelands are held in trust by the United States for the exclusive use of the Lummi Nation.

The tribal commercial shellfish enterprise and the commercial, subsistence, and ceremonial harvest of shellfish by the Lummi Nation and individual members on the Reservation was severely impacted by the closure of 60 acres of tidelands in 1996 and 120 additional acres in 1997. These closures occurred in Portage Bay and were largely attributed to poor dairy waste management practices in the Nooksack River watershed (DOH 1997). Not considering the multiplier effects on the economy, the lost value of the shellfish products alone was estimated to be approximately \$825,000 per year. In response to the 1996 closure, the EPA conducted compliance enforcement inspections of dairy operations in the Nooksack River watershed starting in 1997, the State of Washington passed the 1998 Dairy Nutrient Management Act (RCW 90.64), and dairy farmers developed and implemented nutrient management plans (a.k.a. farm plans). As a result of these reactions and additional compliance inspections by the Washington Department of Ecology (Ecology), water quality in the Nooksack River has improved. In November 2003, approximately 75 percent of the previously closed shellfish beds in Portage Bay were reopened to commercial harvest.

The Lummi Casino project began in 1983 in an effort to diversify the Reservation economy. The casino operation was upgraded significantly in 1994 with the opening of the Lummi Casino at Fisherman's Cove. The casino flourished initially, employing approximately 400 people, 65 percent of whom were Native American (LIBC 1996). However, competition and changing economic conditions resulted in the closure of the casino on August 26, 1997. With 238 workers losing their jobs, the Lummi unemployment rate grew to approximately 50 percent. A new casino opened in April 2002 at a new location (the corner of Haxton Way and Slater Road) that is closer to the Interstate 5 highway. The new casino (Silver Reef Casino) employs approximately 200 people in a range of positions paying from \$16,000 to \$60,000 per year. A casino expansion project is currently underway and expected to become operational in April 2004. Adjacent to the proposed casino site, the LIBC operates a gas station and mini-mart.

Other employment opportunities exist at the two oil refineries and the aluminum smelter (though it is threatened with closure because of increased electricity costs) just north of the Reservation and nearby in the communities of Ferndale and Bellingham. In addition, 15 to 20 small businesses are located on the Reservation.

The LIBC is the 13th largest employer in the Whatcom County area and a major employer on the Reservation today. Most of the LIBC and Northwest Indian College employees are tribal members. The LIBC provides community, administrative, education, and health services to the tribal population in order to help achieve the tribal economic and social development goals. These goals include job creation for tribal members, income generation to fund community development programs, and diversification and stabilization of the local economy by creating alternatives to fishing. Revenue generation is needed in order for the Lummi Nation to develop economic self-sufficiency.

In 1993, 56 percent of the 2,500 working-age Lummi tribal members were unemployed, under-employed, full-time students, or no longer seeking work (LIBC 1996). Since 1993, the combined effect of the decline in the fishery and the closure of the original casino has had a substantial negative impact on the Lummi economy. The BIA reported that the unemployment rate on the Reservation in 1999 was 21 percent (BIA 1999). Table 3.2 presents the results of a survey of 2,054, over-18, enrolled tribal members conducted by the LIBC in 2003 (LIBC 2003). This survey indicates that 28 percent of adult tribal members are unemployed and up to 14 percent may be underemployed (part-time plus seasonally employed).

Table 3.2 Employment Status of Lummi Tribal Members, 2003¹

Employment Status	Number in Status	Percentage of Surveyed Individuals
Employed full-time	825	40.2
Employed part-time	156	7.6
Employed seasonally	133	6.5
Self-employed	84	4.1
Retired	127	6.2
Unemployed	576	28.0
Not available for employment	153	7.4

¹2003 Lummi Tribal Survey, LIBC Statistics Office.

3.2 TOPOGRAPHY

The Lummi Reservation is comprised of two relatively large upland areas on the mainland, a smaller upland area on Portage Island, and two distinct lowland areas (the floodplains of the Lummi and Nooksack rivers and the Sandy Point Peninsula). The maximum elevation of the northwestern upland area of the Reservation is about 220 feet above mean sea level (ft msl). The southern upland area is the Lummi Peninsula with a maximum elevation of about 180 ft msl. The maximum elevation on Portage Island is about 200 ft msl. The floodplain of the Lummi and Nooksack rivers, with an average elevation of approximately 10 ft msl, lies between the northern and southern upland areas. The Nooksack River and the Nooksack River delta are located along the northeastern extent of the Reservation. The Sandy Point Peninsula lies to the southwest of the northwestern upland. Figure 3.7 displays these geographic locations, the topography, and the major roads on the Reservation.

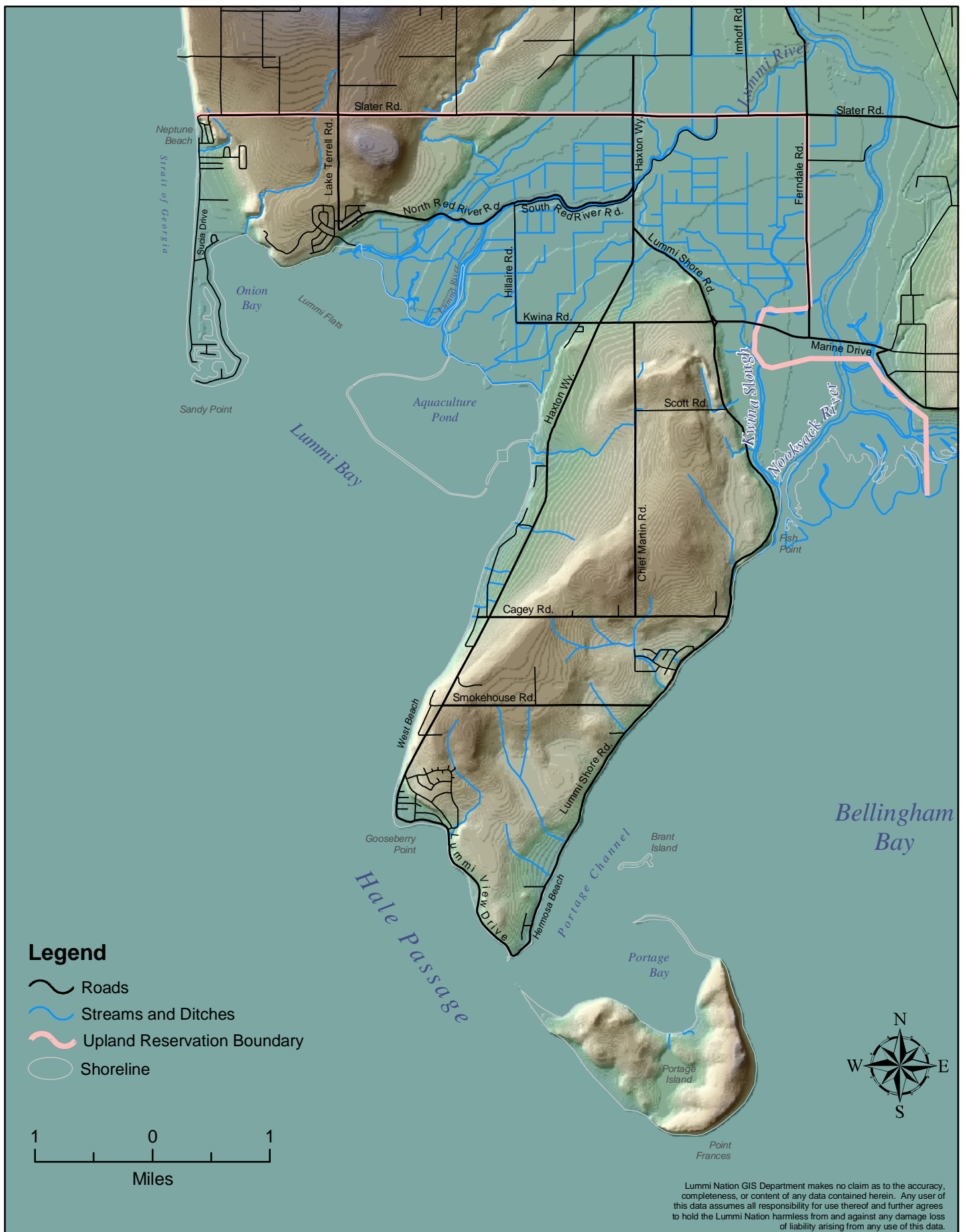


Figure 3.7 Topography, Surface Water Drainages, Place Names, and Roads of the Lummi Reservation



The upland and lowland areas of the Reservation total about 12,500 acres; the Reservation tidelands total approximately 7,000 acres. Individual tribal members or the Lummi Indian Business Council (LIBC) own approximately 75 percent of the upland area; 100 percent of the tideland areas are held in trust by the United States for the Lummi Nation.

During times of severe flooding from the Nooksack River, the Lummi Peninsula and Lummi Island (which is accessed by a ferry that lands at Gooseberry Point) are isolated from mainland service, supplies, and emergency response, resulting in a threat to human health and safety.

3.3 CLIMATE

Based on climate data collected at the Bellingham Airport, the average annual precipitation on the Reservation over the 1960-1990 “normal” period is approximately 36 inches. On average, November, December, and January are the wettest months; June, July, and August are the driest months. About 75 percent of the average annual precipitation occurs from October through April; the remaining 25 percent occurs from May through September.

Wind data for Bellingham indicates that the prevailing wind direction on the Reservation is from the south and southwest, with gusts upward of 80 miles per hour. Winds from the west are not as common and generally not as strong (Corps 1997). However, strong winds from the west-northwest, coupled with a high tide, have resulted in damaging coastal flooding along the Sandy Point Peninsula and coastal erosion along the Lummi Peninsula (see Section 4).

The Reservation experiences a variety of infrequent weather patterns. A typical but infrequent weather pattern is generated from the northeast by cold air masses moving down the Fraser River valley. Strong winds from this pattern, blowing across the Fraser and Nooksack river basins, has caused damage to the residents and businesses of the Reservation (USDA 1992). Another typical but infrequent weather pattern involves continental air masses from the east that bring unusually dry weather that can last a few days or weeks (USDA 1992). During the summer, these air masses bring unusually warm temperatures (mid to upper 90°s Fahrenheit). During the winter, these air masses usually bring cold temperatures (0°F and colder).

Because most of the precipitation occurs during the winter months when evapotranspiration demand is low, all of the ground water recharge and most of the storm water runoff occurs during this season. After the rainy season and during the summer months with low rainfall and high evapotranspiration demand, vegetation slows the movement of storm water and the amount of water available for ground water recharge or surface water runoff is small.

3.4 HYDROGEOLOGY

The hydrogeologic conditions on the Lummi Reservation have been described previously by the USGS and others (Washburn 1957, Cline 1974, Easterbrook 1973, Easterbrook 1976). In general, the Reservation is underlain by unconsolidated sediments deposited as glacial outwash, glaciomarine drift, glacial till, and floodplain or delta deposits of Quaternary age (Washburn 1957). The unconsolidated deposits

consist of clay, silt, sand, gravel, and boulders. Because the composition of the deposits commonly change over short vertical and horizontal distances, it is difficult to distinguish the different stratigraphic units from the existing well log data.

3.4.1 Reservation Aquifers

Ground water in Reservation aquifers is obtained primarily from outwash deposits of sand and gravel in the unconsolidated glacial sediments, which are recharged by local precipitation. Glaciomarine drift is at or near the ground surface over much of the upland areas on the Reservation. The glaciomarine drift overlays the outwash deposits and contains substantial amounts of clay. This clay restricts the recharge to the underlying aquifer and promotes storm water runoff.

The floodplain of the Lummi and Nooksack rivers, which contains a surface aquifer that is saline (Cline 1974), separates the potable water systems in the northern and southern upland areas of the Reservation. A third potable water system may exist on Portage Island, but information on the water quality and the potential yield of this system is limited and inconclusive (LWRD 1997).

Because the hydrogeologic conditions on the Reservation vary considerably over short distances, the precise locations of the aquifer recharge zones are not definitively known at this time. Until information that is more precise is developed, all of the northern and southern upland areas on the Reservation are assumed to be aquifer recharge zones. Since the sources of potable water within these zones are outside of the floodplain and coastal flood-prone areas, flooding in these flood-prone areas will not degrade ground water quality in the Reservation aquifers. Further information is provided in the Lummi Nation Wellhead Protection Program - Phase I Report (LWRD 1997).

3.4.2 Hydrologic Soil Groups

The United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) identified and described 39 different soil map units on the Reservation (USDA 1992). As part of the USDA-NRCS characterization, each soil type was assigned to one of four hydrologic soil groups based on their runoff-producing characteristics.

The primary consideration in assigning a soil to a hydrologic soil group is the inherent infiltration capacity of the soil with no vegetation (USDA 1992). The hydrologic soil groups, which are labeled A, B, C, or D, are described in Table 3.3. In essence, Group A soils have a low runoff potential and a correspondingly high infiltration potential whereas Group D soils have a high runoff potential and a low infiltration potential. The runoff and infiltration potentials of Group B and Group C soils are between those of Group A and Group D soils.

As shown in Table 3.3, about 13 percent of the soils on the Reservation have a low or moderately low runoff potential (Group A or Group B). The remaining 87 percent of the soils on the Reservation have a moderately high or high runoff potential (Group C or Group D). These soil characteristics suggest that less than 15 percent of the Reservation uplands have a good aquifer recharge potential.

Table 3.3 Descriptions of Hydrologic Soil Groups on the Lummi Reservation

Hydrologic Soil Group	Description ¹	Percent of Reservation Soils
A	Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep (3-6+ ft), well- to excessively drained sands (loamy sands, sandy loam, and sands) and/or gravel. These soils have a high rate of water transmission and a low runoff potential.	2.7
B	Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep (20+ inches) and moderately well- to well-drained soils with moderately fine to moderately coarse textures (loam, silt loam). These soils have a moderate rate of water transmission and a moderately low runoff potential.	10.0
C	Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water and (2) soils with moderately fine to fine texture (sandy clay loam) and a slow infiltration rate. These soils have a slow rate of water transmission and a moderately high runoff potential.	40.4
D	Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential, (2) soils with a high permanent water table, (3) soils with clay pan or clay layer at or near the surface, and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission and a high runoff potential.	46.9

¹ USDA 1970

As shown in Figure 3.8, the Group C and D soils are found in much of the upland areas and in the floodplain of the Lummi and Nooksack rivers. Most of the northern and southern upland areas on the Reservation have a moderately high or high runoff potential. A review of the soil map units in the areas north of the Reservation suggests that most of these soils also have a moderately high or high runoff potential. The low infiltration potential of the soils in the floodplain and Sandy Point areas of the Reservation extends the amount of time that impounded floodwaters and local ponding of water cover the ground.

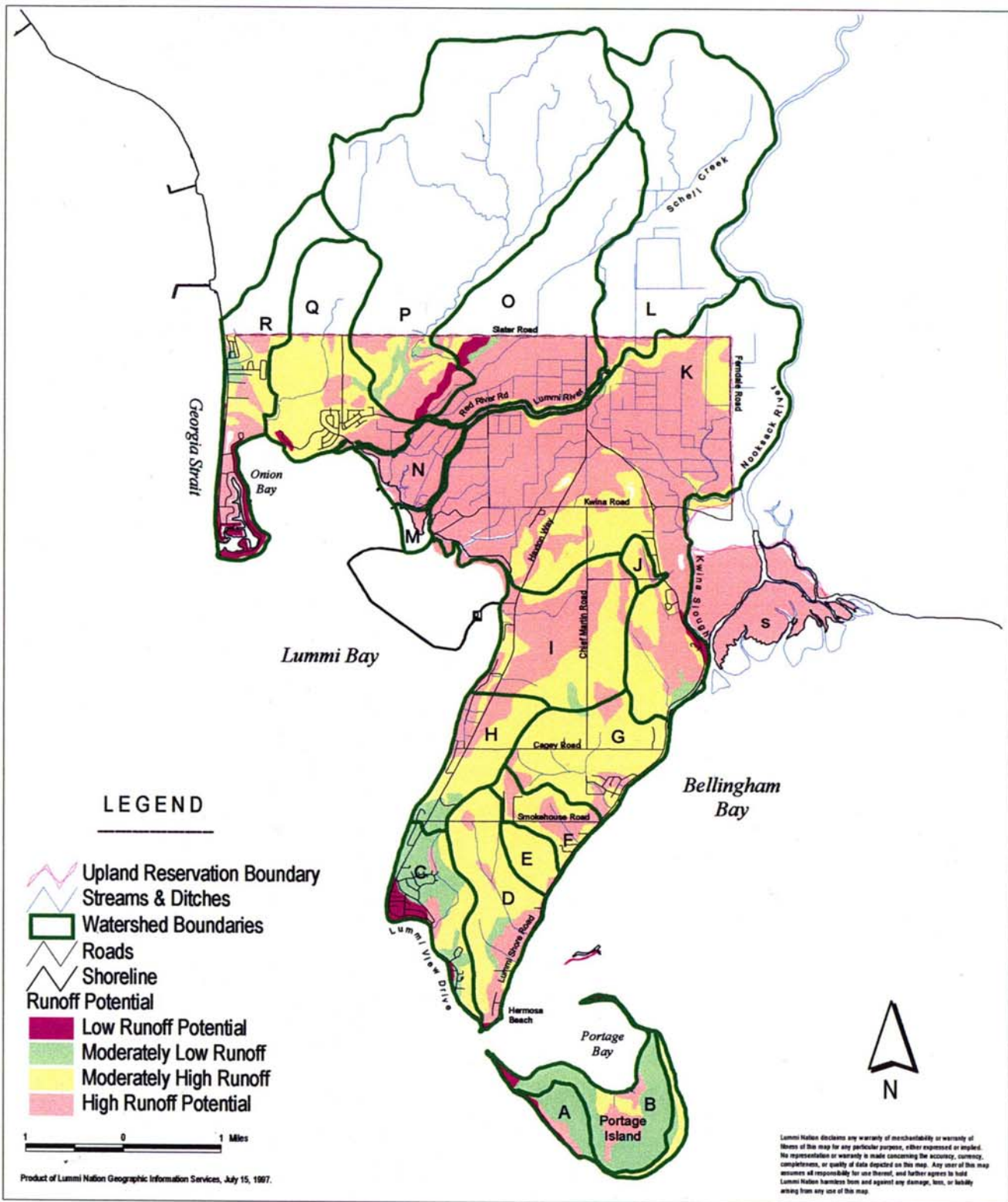


Figure 3.8 Hydrologic Soil Groups, Watersheds, and Surface Waters of the Lummi Reservation



3.5 RESERVATION WATERSHEDS

Reservation watersheds were delineated and mapped during the development of the Lummi Reservation Storm Water Management Program Technical Background Document (LWRD 1998). The watershed boundary map developed as part of the SWMP is a working map that is intended to change as new information is acquired. The working map was modified (Figure 3.8) to account for field observations made during the field verification element of the comprehensive wetland inventory of the Reservation (Harper 1999; LWRD 2000a). Further modifications are anticipated as new Digital Elevation Models are obtained and additional field research is conducted on the Reservation and in the watersheds that extend off-Reservation.

Alphabetic letters (A through S) identify the Reservation watersheds on an interim basis (Figure 3.8). It is anticipated that names will be assigned to the watersheds over time. Nineteen watersheds drain the Reservation uplands into Lummi and Bellingham bays, Hale Passage, and Georgia Strait. Seven of these watersheds originate off-Reservation and the remaining twelve occur entirely within the Reservation.

3.6 SURFACE WATER RESOURCES

Surface waters on the Lummi Reservation include the Nooksack River, the Lummi River, sloughs, small streams, roadside and agricultural ditches, springs, wetlands, estuaries, and marine waters. Short intermittent streams and numerous springs drain the Reservation uplands. The springs occur both above and below the high tide line. These streams and springs discharge onto tribal tidelands along Bellingham Bay, Portage Bay, Hale Passage, Lummi Bay, Onion Bay, and Georgia Strait, or to the floodplain of the Lummi and Nooksack rivers. The floodplain is drained by a network of agricultural drainage ditches and by the Lummi and Nooksack rivers (Figure 3.7). These surface waters are described in this section. The locations of most of these features were shown previously in Figures 3.7 and 3.8 or are shown in Figure 3.9.

3.6.1 Rivers, Sloughs, Streams, and Ditches

The Nooksack River drains most of western Whatcom County and currently discharges to the marine water of Bellingham Bay near the eastern extent of the Reservation. The Nooksack River reach located on the Lummi Reservation is tidally influenced. Streamside levees are in place to protect agricultural lands from flooding. Several named sloughs, which are the remains of former river channels, have been incorporated into the agricultural drainage network built on the floodplain of the Lummi and Nooksack rivers. Kwina Slough, a distributary channel on the Nooksack River delta, was used as the water source for the Seaponds salmon hatchery until March 2004. However, because this water source is unreliable and withdrawals from the channel may negatively impact salmon habitat in this area, the intake was moved to the mainstem of the Nooksack River and began operation in March 2004.

In general, the Lummi River currently carries storm water runoff from the Ferndale upland as well as the drainage from a complex network of agricultural ditches in the floodplain. Tidal waters enter the Lummi River from Lummi Bay twice daily and, during the dry season, saline water extends as far upstream as Slater Road. Although Nooksack River water currently flows through a four-foot culvert into the Lummi River channel only during high-flow events (greater than approximately 10,000 cfs), available

data indicate that the Lummi River flow was around 200 cfs as recently as June 1955 (WSDC 1964), when a five-foot culvert allowed fresh water to flow from the Nooksack River into the Lummi River channel (Deardorff 1992).

There are several mapped and previously unmapped streams on the Reservation. Most of the unmapped streams have poorly defined channels and contain surface flow only during the October through May period. The approximate locations of these streams were identified as part of the 1997 inventory of storm water facilities on the Reservation (LWRD 1998). No flow was observed during a field survey of all Reservation streams in late August 1996, leading to the conclusion that, other than the Nooksack and Lummi rivers, there are no perennial streams on the Reservation.

3.6.2 Springs and Wetlands







Upland springs are found throughout the Reservation and are commonly ground water discharge zones for shallow, perched aquifers. A seep or spring occurs if the land surface intercepts the aquifer, and wetlands may occur at the seep or spring if conditions are favorable (e.g., clayey soils, shallow slope). In addition to upland springs, springs occur along the shoreline, below the ordinary high water line (vegetation line), at numerous locations on the Reservation.

Historically, springs emerging in the uplands served as a water supply for the Lummi people. In many cases, they are part of a wetland system in which the water reinfilters along the lower terraces to return to ground water. The springs are important for wildlife habitat and for aquifer recharge and protection. Upland aquifers, which provide the primary Reservation drinking water supply as well as the water for salmon egg incubation and rearing in the hatchery program, have experienced depletion and saltwater intrusion. Where it occurs, the infiltration of fresh water above the shorelines provides a buffer against saltwater intrusion.

The 1999 comprehensive inventory of Reservation wetlands (Figure 3.9; Harper 1999; LWRD 2000a) indicated that approximately 43 percent of the Reservation land area is either wetlands or wetland complexes. Wetland complexes are areas where wetlands and uplands form a highly interspersed mosaic. During the wetland inventory, boundaries were drawn around the outer edges of the mosaic of upland and wetland areas and the entire area was labeled as a “wetland complex”. Consequently, the estimated total wetland area identified in the inventory represents more wetland area than actually exists. Some of the wetlands and wetland complexes found in the comprehensive inventory were classified as agricultural and forest land cover areas (instead of as wetlands) in Table 3.1. About 50 percent of the total area of wetlands and wetland complexes identified on the Reservation in 1999 is located in the floodplain of the Lummi and Nooksack rivers. Approximately 60 percent of the floodplain on the Reservation was classified as wetlands or wetland complexes (Lynch 2001).

Most of the once extensive floodplain wetlands of the Lummi and Nooksack rivers have been diked, drained, filled, and cultivated since the late 1800s. Low areas near some of the sloughs still reflect the rich and complex wetland habitat that likely covered most of the lower floodplain before human alteration. Small estuarine wetlands lie in sheltered, low energy areas at Onion Bay, Neptune Beach, Portage Island, the Lummi River floodplain, the Nooksack River delta, and adjacent to the Seaponds dike.

Legend

-  Roads
-  Streams and Ditches
-  Upland Reservation Boundary
-  Wetland
-  Wetland Complex
-  Floodplain
-  Shoreline

1 0 1
Miles



The Lummi Nation GIS Department makes no claim as to the accuracy, completeness, or content of any data contained herein. Any user of this data assumes all responsibility for use thereof and further agrees to hold the Lummi Nation harmless from and against any damage loss of liability arising from any use of this data.

Figure 3.9 Wetlands, Streams, and Riverine Floodplains of the Lummi Reservation



Road construction and agricultural activity have altered the wetlands that are north of Marine Drive and adjacent to the Nooksack River. South of Marine Drive, many of the wetlands in the Nooksack River delta have been physically altered by the accumulation of sediment deposited by the Nooksack River as it discharged to the marine waters of Bellingham Bay. The Nooksack River delta was identified as the fastest growing delta relative to its basin size in Puget Sound, with a progradation of approximately one mile over the 1888 - 1973 period (Bortleson et al. 1980). Consequently, a large area that was once intertidal is now supratidal and new wetlands have been formed. In addition to the delta progradation, the wetlands of the Nooksack River delta are likely affected by the low instream flows and poor water quality that characterizes the river during some summer months.

Remnants of what were once extensive, high-value wetlands are located on the Sandy Point Peninsula between Sucia Drive and the private Sandy Point marina. The private Sandy Point marina and its associated canal system were excavated in the 1960s from uplands that were periodically inundated by marine waters. Road construction, dense residential development and associated shore defense works, and drainage facilities now limit tidal inundation, but wildlife and wetland vegetation is abundant. Plants of traditional cultural significance have been identified in this area. Further north along Sucia Drive, formerly dry and seasonally wet areas are now permanently flooded as a result of road construction that blocked natural drainage.

These palustrine/estuarine emergent wetlands of the lowlands/floodplains are significant for storm water attenuation, floodwater storage, water quality enhancement, fish habitat, wildlife habitat, and for plants with traditional cultural importance. The estuarine wetlands provide critical rearing habitat for migrating salmon, herring, smelt, and other finfish and shellfish. The significance of these wetlands is increasing as wetlands upstream from the Reservation are altered and destroyed. These Reservation wetlands reduce the water quality impacts of off-Reservation land uses on Lummi commercial and subsistence shellfish beds in Portage and Lummi bays. Protecting and enhancing floodplain and estuarine wetlands is essential to preserving and/or restoring interdependent fish, shellfish, and wildlife habitats in addition to reducing flood damage.

3.6.3 Estuarine and Marine Waters

Brackish estuarine waters grade to marine waters of the Reservation in Lummi Bay, Portage Bay, portions of Bellingham Bay and Hale Passage, and the shoreline along Georgia Strait. Saline water moves across tideflats and into the Lummi and Nooksack river channels twice daily with the tidal cycle. The salt water underlies the less dense fresh water and moves as a wedge upstream. Salt water has been measured upstream as far as Slater Road in the Lummi River and nearly to the fork between the west and east distributaries of the Nooksack River. Tidal effects on the water level (backwater effects) in the Nooksack and Lummi rivers have been observed even further upstream (and possibly occur as far upstream as Ferndale).

Brackish estuarine waters of the Nooksack and Lummi river deltas form the interface between marine and fresh water. Estuarine waters are important habitat for juvenile and adult salmon as they acclimate to either saline or fresh waters during their seaward and landward migrations, respectively. Estuaries also serve as habitat for juvenile and adult life stages of many other important aquatic species.

Estuarine wetland ecosystems, including saltwater marshes, in general are considered among the most productive (in biomass production per unit area) natural ecosystems on earth. In addition to providing rearing habitat for juvenile salmonids and other species, these ecosystems export a large amount of biomass to estuaries. This biomass can form a large portion, sometimes the majority, of the base of the estuarine food web (Mitsch and Gosselink 1993, as described in LWRD 2000b). Small estuarine marshes in Lummi Bay occur in sheltered fringes of diked areas. As mitigation for wetland filling at the new casino site north of the Lummi River, a 17.1-acre saltwater marsh was restored along the waterway adjacent to the Lummi Bay seawall in August 2001.

The complex and rich aquatic resources that provide feeding grounds for fish also attract a large variety of wildlife. The estuaries of the Lummi and Nooksack rivers are a part of a major Pacific Coast flyway for ducks, geese, swans, and shorebirds. These estuaries are also habitat for the threatened and endangered bald eagle and peregrine falcon as well as numerous other birds of prey.

Lummi Bay tideflats are extensive and rich in resources for tribal subsistence and as feeding areas for wildlife. Less extensive tideflats at Gooseberry Point, the Stommish Grounds, and Portage Bay are also important to the tribal economy and culture.

3.7 STORM WATER RUNOFF

As shown in Figures 3.7 and 3.8, there are numerous intermittent streams and agricultural drainage ditches on the Reservation. These channels convey storm water either to the surrounding marine waters or to the floodplains of the Lummi and Nooksack rivers. As described previously, 87 percent of the soils on the Reservation are in Hydrologic Soil Groups C or D (soils with moderately high to high runoff potential). The presence of these soil types on the Reservation, coupled with the drainage enhancements, suggest that a large percentage of the winter precipitation becomes storm water runoff.

Unit runoff maps that were developed as part of a study of the Nooksack River Basin by the Washington State Department of Conservation (WSDC 1960) estimated that the mean annual runoff from the Reservation is about 15 inches per year. This estimate represents about 42 percent of the mean annual precipitation and about half of the precipitation that occurs from October through May.

4. NATURAL HAZARD RISK ASSESSMENT

Fundamental to effective hazard mitigation is general and specific information related to the nature, distribution, probabilities of occurrence, frequency, and severity of historic hazard events (both natural and human-caused). When linked to demographic, economic, infrastructure, structural, and other societal data, risk evaluations and vulnerability assessments can be performed. The amount, availability, and quality of information about different hazards vary widely. Limited information for some hazards results in greater uncertainty in the risk assessment for those hazards. This Multi-Hazard Mitigation Plan is focused on natural hazard mitigation, and a separate effort is underway to develop a spill prevention and response plan to address human-caused hazards on the Reservation.

The following assessment of natural hazard risks on the Reservation describes the nature and location of past and potential natural hazard events, assesses the vulnerability of Reservation areas to each hazard, estimates the value of structures and/or property in areas that are vulnerable to hazards, and provides an analysis of the risk to life, property, economic activity, and the environment that may result from natural hazard events on the Reservation. In the first subsection, the natural hazards on the Reservation are identified. Each hazard is then defined; past hazard events are described; the vulnerability of residential units, LIBC facilities, and the facilities of other organizations on the Reservation is assessed; and the potential losses to these residences and facilities are estimated. In the final subsection, the relative vulnerability of Reservation areas and critical LIBC facilities is summarized.

The PDM program rules require tribes that are submitting a "State" plan to assess hazard risks by jurisdiction. Since the LIBC is the only governing body for the Lummi Reservation, there are no local jurisdictions. As a result, this MHMP defines six geographic areas of the Reservation as "jurisdictions" and assesses and compares the relative hazard risks within these six areas. Organizing the risk assessment in this way meets the jurisdiction requirement of the PDM program rules and simplifies the assessment and interpretation of relative risks to developed areas on the Reservation. The six assessment areas are labeled the Sandy Point Peninsula, Northwest Upland, Floodplain (Nooksack and Lummi river floodplains), Lummi Peninsula, Gooseberry Point (for the coastal flooding area at the southwest corner of the Lummi Peninsula), and Portage Island. The Portage Island assessment area is currently unoccupied and undeveloped. As a result, it was assessed for hazard vulnerability, but not for potential losses. Figure 4.1 identifies these six areas of the Reservation. For the purpose of this assessment, the Seaponds dike and hatchery buildings in Lummi Bay are considered as part of the Floodplain assessment area.

After a brief description of the methods used to identify hazards in each assessment area and the methods used to conduct a vulnerability assessment for each hazard, the remainder of this section addresses each of the natural hazards of concern on the Reservation. Profiles of past events, an assessment of vulnerability, and potential losses are presented for each of the natural hazards.

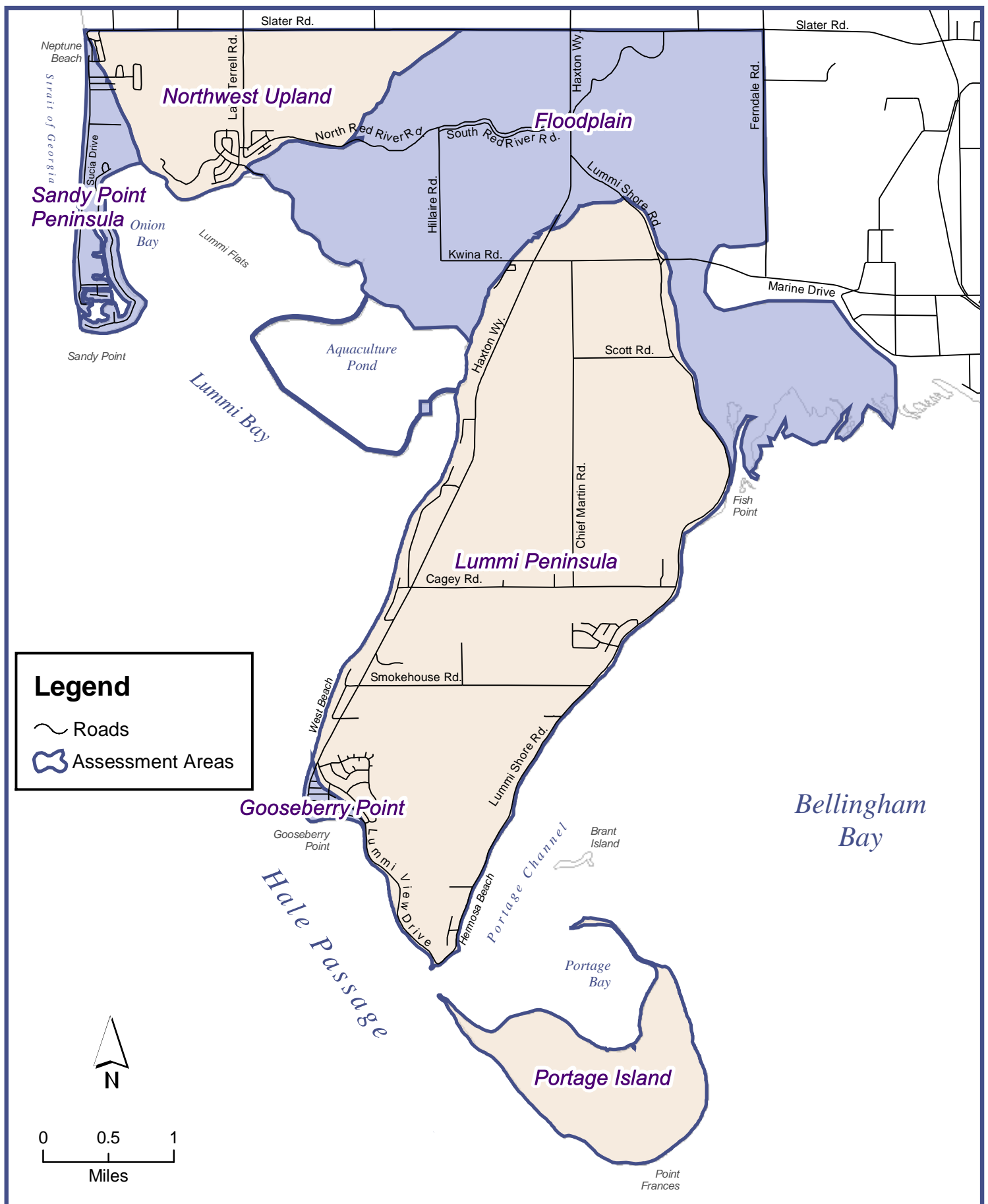


Figure 4.1 Hazard Assessment Areas on the Lummi Reservation

4.1 HAZARD IDENTIFICATION AND VULNERABILITY ASSESSMENT METHODS

The Lummi Nation Natural Resources Department took the following steps to identify hazards that have affected the Reservation in the past and/or can be expected to affect the Reservation in the future:

- Review of past state and federal disaster designations;
- Review of regional hazard information and analyses prepared by state, federal, and Canadian agencies and reports prepared by university researchers;
- Review of Internet web sites containing regional hazard information;
- Review of the Washington State Hazard Identification and Vulnerability Assessment (WEMD 2001) and the Whatcom County Hazard Identification and Vulnerability Analysis (Whatcom County 2002); and
- Review of the Revised Preliminary 2003 Flood Insurance Rate Maps (FEMA 2003b); Nooksack River Flood History (Whatcom County 1995a); Lower Nooksack River Comprehensive Flood Hazard Management Plan (Whatcom County 1999); and the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a).

The natural hazards that have affected the Reservation in the past and will affect the Reservation in the future are floods, earthquakes, severe winter storms, coastal erosion, windstorms, wildfires, drought, and landslides. In addition, volcanic activity from Mt. Baker and a tsunami (commonly called a "tidal wave") have a low probability of occurrence, but are potentially large hazards on the Reservation. As a result of the literature review described above and feedback gained from public review of the Draft Lummi Nation Multi-Hazard Mitigation Plan, all of the above natural hazards are assessed in this plan.

Information acquired from the materials listed above was also used to estimate the vulnerability of the Reservation assessment areas to each hazard. This information included the probability of occurrence of hazard events, the types of damage associated with a hazard, and the relative vulnerability of each assessment area. After compiling this hazard information, areas of the Reservation vulnerable to the hazards were identified. The estimated relative levels of vulnerability for each hazard assessment area were based on the following factors:

- Probability of damage resulting from a large hazard event;
- Types of damage associated with the hazard;
- Historic and/or potential severity of damage;
- Potential damage relative to other hazards; and
- Vulnerability of each area relative to other areas, both within the Reservation and in other regions.

The relative probability of hazard occurrence (between hazards) is not reflected in the vulnerability assessments. For example, although the Floodplain assessment area was rated as having a high vulnerability to both floods and volcanoes, it is much more likely to be affected by floods. The ratings for each hazard therefore reflect the estimated

vulnerability if a large hazard event occurs. In addition, the amount of development in each assessment area was not factored into the estimated vulnerability for an area. For example, although the Sandy Point Peninsula and Floodplain areas have very different levels of development, they have the same estimated earthquake vulnerability. Different levels of development are reflected in the estimated potential losses for each area: highly developed areas have greater potential losses.

4.2 FLOODS

Flooding in riverine systems is a natural occurrence that results when runoff from rain or snowmelt exceeds the carrying capacity of river channels, ditches, drains, reservoirs, and other waterbodies. Flooding in coastal areas is a natural occurrence that results when high tides and/or storm-driven waves overtop naturally created storm berms or man-made shore defense works. In this section, past riverine and coastal flood events, flood vulnerability, and potential flood losses on the Reservation are described.

4.2.1 Profiles of Past Flood Events

Flood events on the Lummi Reservation can be divided into two broad categories: (1) flooding of the Nooksack River and (2) coastal flooding along the approximately 38 miles of marine shoreline. During the 1990s, Nooksack River flood damage occurred at least five times on the Reservation in the Nooksack and Lummi river floodplains, while coastal flooding occurred at least eight times since 1993, causing substantial damage at least three times (2000, 2001, and 2003). The history and locations affected by flooding on the Reservation are described in this section.

4.2.1.1 Nooksack River Floods

As described previously, the Nooksack River drains a watershed of approximately 786 square miles. The river historically discharged primarily to Lummi Bay, but since around 1860 it has discharged primarily to Bellingham Bay (WSDC 1960). Both of these river deltas are located on the Reservation.

Most major floods recorded on the Nooksack River occurred from late October through February. The position of the watershed on the west slopes of the Cascade Mountains results in large amounts of rainfall during warm and wet winter storms. The combination of a heavy storm, a melting low-elevation snowpack, and soils already saturated by preceding rainfall results in the most severe floods of the Nooksack River. Since over 70 percent of the watershed is in the mountainous areas above the City of Deming where precipitation is relatively high, the upper basin areas of the watershed contribute most to flood volumes (Whatcom County 1995a).

The November 10, 1990, (Veteran's Day) Flood was typical of a severe Nooksack River flood. In the three days before the flood peak, ten to twelve inches of rain fell in the upper reaches of the watershed. Snowmelt above 2,500 feet was equivalent to several more inches of rainfall. Precipitation in the lowlands was six to seven inches (Corps 1991). This flood was the highest on record at the Ferndale river gage, approximately two miles north of the Reservation. With a calculated flow of 57,000 cubic feet per second (cfs), it was estimated to be a 59-year flood (i.e., to have an average return frequency of once in 59 years, which translates to a 1.7 percent chance of occurring in any given year) (Whatcom County 1995a).

Large floods of the Nooksack River have occurred throughout history, even before development in the floodplain and land use changes in the upper watersheds. The fact that floods will cause more damage today than several decades ago is more a result of the increasing amount of development susceptible to flooding than a result of increased flood magnitude. However, increased surface runoff and isolation of the river from floodplain storage areas due to environmental alterations by humans have combined to increase downstream flows and hence the magnitude of floods.

The largest recorded floods of the Nooksack River are listed in Table 4.1. (Stream gage records began in 1935 at Deming and in 1945 at Ferndale.) Also included in Table 4.1 are current estimates of the 10-, 50-, and 100-year flood flows for the Nooksack River at Ferndale, Washington. Flows at Ferndale for floods before 1945 are estimated. The information and methods used to develop these estimates are described elsewhere (see Whatcom County 1995a and references therein). Other major known floods before 1935 occurred in 1883, 1891, 1893 or 1894, 1901, and 1927. Data from the adjacent Skagit River basin also indicate extreme floods in Western Washington in 1815, 1856, and 1909 (Whatcom County 1995a).

According to the information compiled in Table 4.1, it is possible that fourteen 10-year floods (including potential 50- and 100-year floods) occurred on the Nooksack River during the 20th century. Two 50-year, five 10-year, and ten 5-year floods (including the 10- and 50-year floods) occurred since 1983. These higher than predicted recurrence intervals could be due to uncertainty in flood magnitude measurements or estimates (particularly at the Deming gage), an insufficient flood history for accurate recurrence interval calculations, and/or an increase in flood magnitudes in recent decades.

Table 4.1 Nooksack River Flood Flows at the Ferndale Gage

Date	Flow (cfs)	Return Period (yr)	Chance (%/yr)	Rank (1945 - 2002)
1815	Very High ¹	n/a ²		
1856	Very High ¹	n/a ²		
March 15, 1908	Very High ¹	n/a ²		
November 1909	Very High ¹	n/a ²		
December 30, 1917	Very High ³	n/a		
December 12, 1921	High ³	n/a		
February 27, 1932	Very High ^{1,3}	n/a ²		
January 25, 1935	Very High ³	n/a ⁴		
October 28, 1937	n/a ⁵	n/a ⁴		
100-year	62,800	100	1.0	
November 10, 1990	57,000 ⁶	59	1.7	1
November 24, 1990	56,600 ⁶	56	1.8	2
50-year	55,500	50	2.0	n/a
February 10, 1951	55,000 ⁶	48	2.1	3
November 11, 1989	47,800 ⁶	22 ⁷	4.5	4
November 30, 1995	47,200 ⁶	23 ⁸	4.3	5
December 3, 1975	46,700 ⁶	23	4.3	6
October 26, 1945	41,600 ⁶	12	8.3	7
January 5, 1984	41,500 ⁶	12	8.3	8
10-year	40,000	10	10.0	n/a
October 21, 2003	39,600	9 ⁸	11.1	9
October 18, 2003	38,500	8 ⁸	12.5	10
January 31, 1971	38,100	8	12.5	11
March 20, 1997	38,100	8 ⁸	12.5	11
December 15, 1979	36,400	7	14.3	13
November 24, 1986	36,000 ⁶	6	16.7	14
November 4, 1955	35,000	6	16.7	15
January 11, 1983	34,200	5	20.0	16
January 16, 1961	30,800	4	25.0	17
February 23, 2002	30,300	4 ⁸	25.0	18
April 30, 1959	30,200	4	25.0	19
February 25, 1986	29,900	3	33.0	20
December 27, 1980	29,700	3 ⁸	33.0	21
January 5, 1969	28,100	3 ⁸	33.0	22
January 9, 2002	28,100	3 ⁸	33.0	22
November 27, 1949	27,500 ⁶	3	33.0	24
February 15, 1982	27,200	3 ⁸	33.0	25
November 20, 1962	26,000	2	50.0	26

¹Historical flood occurred before stream gage was established. Flow estimated from high water marks at Deming or data from the Skagit River (Whatcom County 1995a).

²Estimated return period greater than that of a 100-year flood at Deming or on the Skagit River (Whatcom County 1995a). (Estimates based on Deming data are unreliable.)

³Based on gage data (presumably estimated from high water marks) on the USGS webpage: <http://water.usgs.gov/wa/nwis/> (USGS Site No. 12213100, Nooksack River at Ferndale)

⁴Flow recorded at Deming gage, which is not accurate. An estimated return period is not reliable.

⁵Flow value not available (stream gage not yet in place).

⁶Flow value influenced by upstream Everson-to-Sumas overflow.

⁷Value cited (Whatcom County 1995a) is out of sequence and may be in error.

⁸Values not found in Whatcom County 1995a were estimated by interpolation.

Flood Control Structures and Sequence of Flooding on the Reservation

Figure 4.2 shows the levels of protection provided by levees against Nooksack River flooding below Ferndale (Whatcom County 1997a). The information in Figure 4.2 is based on an inventory of the levee system performed by and for the U.S. Army Corps of Engineers (Corps) in 1988 (Corps 1988; NHC 1988). Whatcom County has developed an unsteady flow model of the lower Nooksack River that will be used to evaluate the existing levee system using levee surveys performed in 2000 (Cooper 2001, 2004). The levees in the City of Ferndale provide protection up to approximately a 60-year flood. During the November 10, 1990 flood, the river rose to within inches of overtopping sandbags on the levee near the Ferndale Wastewater Treatment Plant. The levees of Diking District No. 1 along the west bank of the Nooksack River (south of Ferndale) provide from less than five-year to up to ten-year flood protection. The main purpose of these levees is to prevent agricultural land from incurring damage from frequent floods. The levees along the east bank of this reach also provide from less than five-year up to ten-year protection. Additional flood control structures in this area include levees along the banks of the Lummi River, bank protection made of rip-rap, sea dikes/seawalls along Lummi Bay, tide gates in the Lummi Bay seawall, and floodgates along Lummi Bay and floodplain sloughs.

When the levee along the western side of the lower Nooksack River fails or is overtopped, floodwaters discharge to both Lummi and Bellingham bays. Floodwater moving toward Lummi Bay accumulates landward of the seawall. Although tide gates are designed to prevent tidal/marine waters from flowing inland and allow the floodwater to drain to Lummi Bay, historically they have been overwhelmed and ineffective during large floods. The seawall has been intentionally breached during past floods to allow the floodwaters to drain during lower tides. This draining is largely stopped during higher tides as the marine waters flow inland and “back-up” the floodwaters. Previous breaches of the seawall allowed saltwater at high tide to reach Haxton Way and the farmlands inland of the seawall. After the 1975 flood, the Corps rebuilt a short section of the seawall so that it would wash out under severe flooding. This fuse plug can prevent damage to the rest of the seawall by letting waters pass through only at that designated spot. Fuse plugs are designed to be replaced easily once the flood is over. How well this fuse plug will prevent seawall damage is not yet known (Whatcom County 1997a). If a flood results in a breach of the seawall section next to the Lummi aquaculture pond, extensive damage to this facility can be expected. In addition, in 1998 the six non-functioning tide gates mounted on 36-inch corrugated steel culverts were replaced by five concrete box culverts, four-feet-wide by six-feet-tall, fitted with “flapper” gates made out of aluminum. The effectiveness of these new tide gates has not been “tested” by a flood yet. Three five-foot by five-foot box culverts drain the northern distributary channel of the Lummi River.

One of the first areas to experience flooding on the Reservation as the Nooksack River rises is Marine Drive, west of the bridge crossing the river and just upstream from the delta. North of Marine Drive, the west bank levee follows Kwina Slough away from the main Nooksack River channel. Unprotected and crossing low ground in this stretch, Marine Drive is frequently flooded by low magnitude events (smaller than one-year floods). During the one-year period from the fall of 2001 through the summer of 2002, Marine Drive was flooded by six flood events that closed the road for at least 19 days.

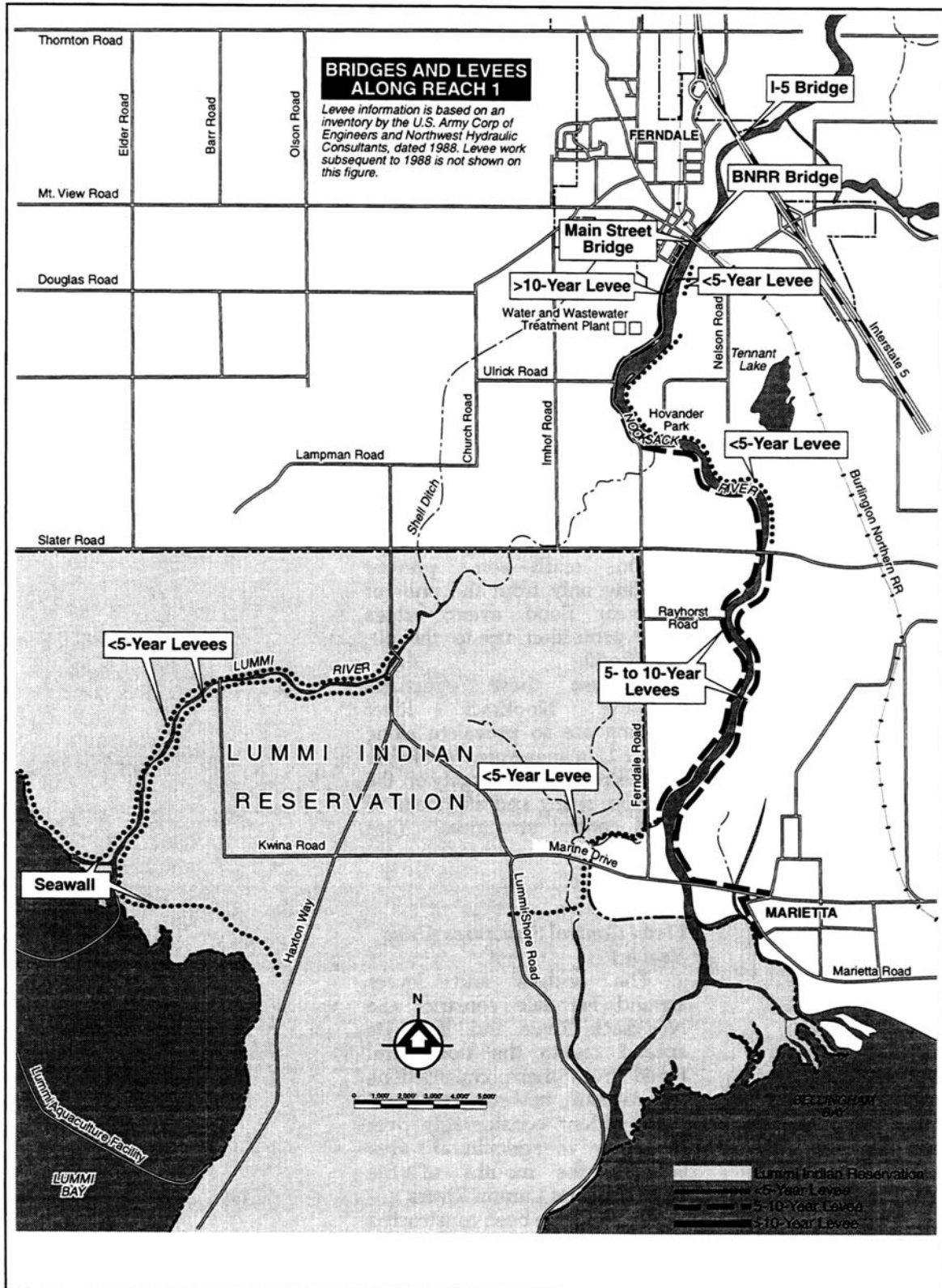


Figure 4.2 Levees along the Lower Nooksack River and Lummi River
(Whatcom County CFHMP 1997)

At flow levels near the five-year flood, the unleveed east bank across from Ferndale is overtopped with floodwaters. The floodwaters follow a natural overbank flow path through Hovander Park and eventually over Slater Road and Marine Drive. The floodwaters then generally threaten to overtop the low, poorly maintained levees surrounding the community of Marietta, on the east bank of the Nooksack River delta. At the level of 10- to 15-year floods, levees on both banks of the river downstream from Ferndale are overtopped, inundating large portions of the Lummi and Nooksack floodplains. The areas of inundation depend on where overtopping or breaching of the levees occurs and on the magnitude and duration of the flood. The Lummi River, levees along the Lummi River, and some roads in the floodplain can restrict floodwaters from spreading across the floodplain. Other roads that pass through the Reservation, including Slater Road, Haxton Way, and Marine Drive, have low elevation approaches to bridges that allow overbank flows to pass relatively unimpeded over the road surface (Whatcom County 1995a).

Major levee breaches have occurred along the lower Nooksack River during all large floods. As shown in Figure 4.4, the floods of 1951, 1971, 1975, 1989, 1990, 1995, and 1997 all caused levees to fail on both banks of the river (Whatcom County 1997a). These levee failures are most often caused by erosion when a levee section is overtopped. The levees may also weaken as the soils become saturated during extended floods, eventually resulting in failure of the levee. A levee failure relieves the pressure on downstream levees because the flow in the channel is reduced (Whatcom County 1995a).

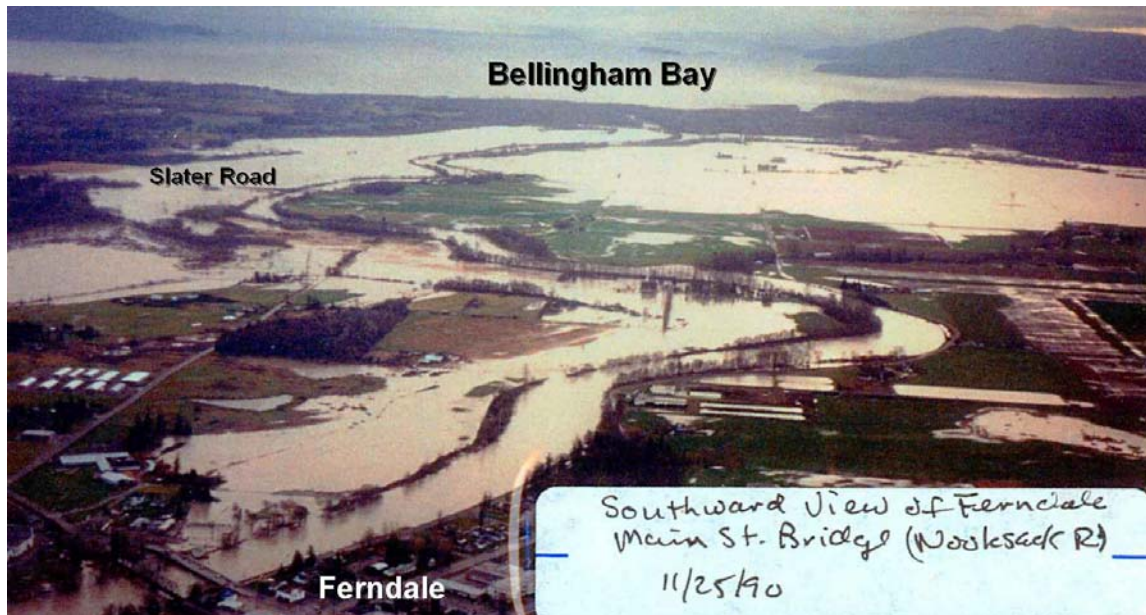
In 1951, a breach occurred about a mile below the Ferndale Wastewater Treatment Plant, flooding the entire Lummi/Nooksack floodplain. In subsequent major floods, levee breaches occurred further downstream and floodwaters were confined to the area between the Nooksack and Lummi rivers. A breach at Rayhorst Road was the main levee failure during the November 10, 1990 flood. Floodwaters from this breach contributed to the inundation of Haxton Way and eventually reached Lummi Bay (Whatcom County 1995a). A breach between Rayhorst Road and Kwina Slough was the main levee failure during the January 1, 1997 flood, which occurred after two ice jams that were each a mile long backed up the Nooksack River above the Slater Road and Marine Drive bridges (Bellingham Herald 1997). This flood inundated Haxton Way for four days (Whatcom County 1997a).

Effects of Recent Floods

During the 1990 floods, five major roads that provide access to and through the Reservation were inundated by floodwaters. These roads are Haxton Way, the major north-south connector, which also provides access to the Lummi Island ferry; Ferndale Road; Lummi Shore Road, north and south of Kwina Road; Marine Drive, the major access road to Bellingham from the Reservation; and Slater Road, the major access road along the northern boundary of the Reservation. Figure 4.3 presents photographs of the November 24, 1990, flood on the Reservation. Figure 4.4 shows the approximate area of inundation during the November 1990 floods.

Inundation of homes and properties caused significant damage on the Reservation during these floods. Approximately 20 private residences, two businesses, and two natural resource production facilities were inundated by the 1990 floodwaters. Approximately 4,100 acres of land on the Reservation were flooded. Most of the flooded

View from Ferndale along the Nooksack River to Bellingham Bay



View along the Lummi River out to Lummi Bay



Figure 4.3 Flooding on the Reservation, November 25, 1990

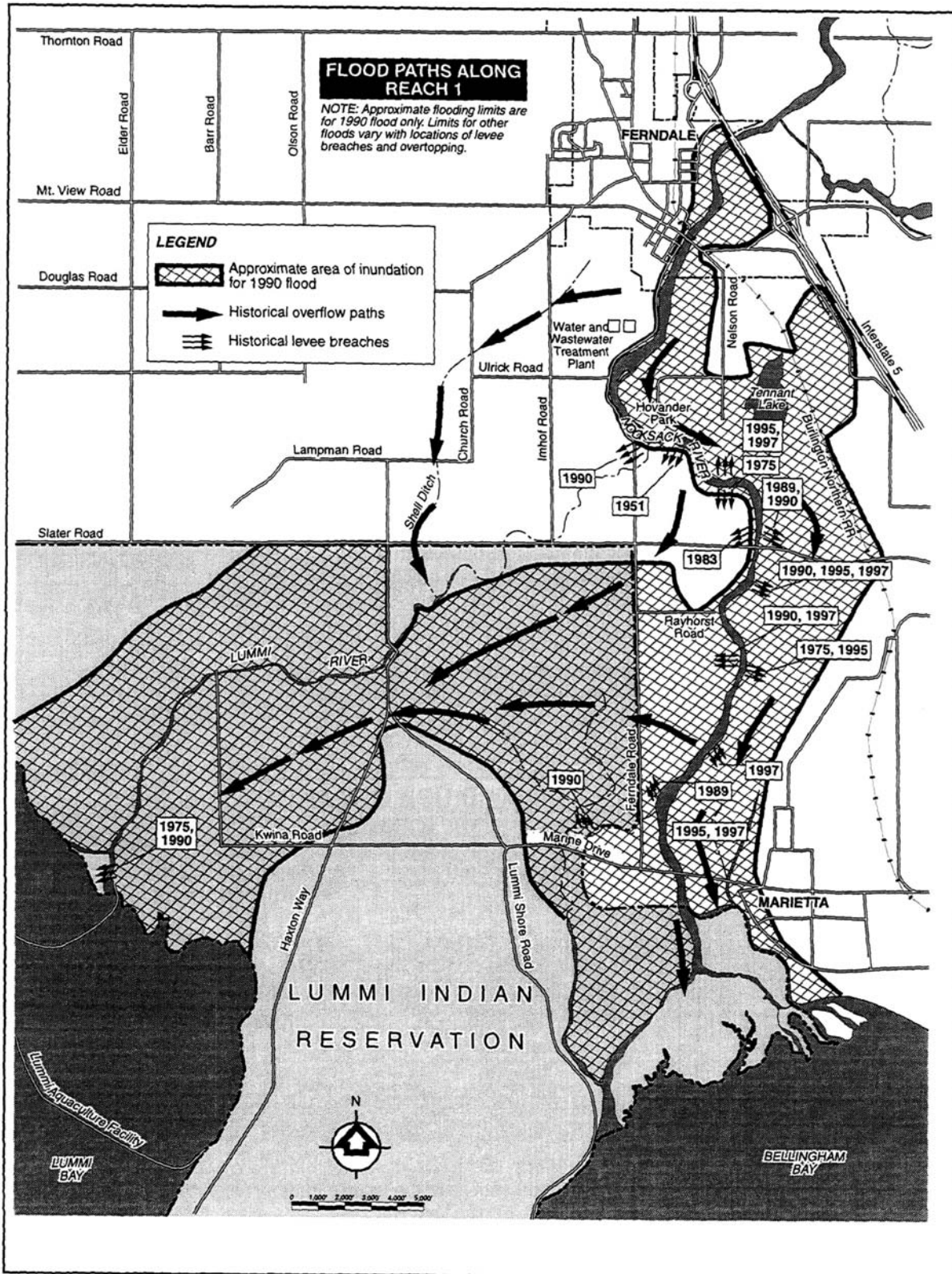


Figure 4.4 Area of Inundation (November 1990) and Historical Levee Breaches
(Whatcom County CFHMP 1997)

land was in agricultural use. Damage included deposition of sediment and debris on fields, erosion of topsoil near levee breaks and high velocity constriction points, and damage to fence lines and drainage structures in fields. Road damage included loss of road surfacing on North Red River Road and Marine Drive (Scott 1995).

In addition to causing erosion, high velocity floodwaters can threaten the physical integrity of buildings and other infrastructure on the Reservation. During the 1990 flood, levee breaches on the west bank of the Nooksack River allowed floodwaters to rush westward towards the intersection of Lummi Shore Road and Haxton Way, where floodwater velocities were reported to be very high. Several buildings, roads, and public water lines in the area were in danger of receiving substantial damage from the rapidly flowing floodwaters. To relieve the pressure of built-up water behind the Lummi Bay seawall during the 1990 and 1975 floods, the dike was intentionally breached at a point between the Lummi River outlet and the north end of the Aquaculture Dike. This breach and subsequent outflow of floodwater eroded portions of the aquaculture dike (Scott 1995).

Damage from the November 1995 flood included sedimentation in Kwina Slough, erosion and a breach of the Kwina dike, closure of Marine Drive, and erosion of the west bank of the Nooksack River upstream from the Marine Drive bridge (Thompson 1996). After the 1997 flooding, approximately \$750,000 was obtained from the Federal Emergency Management Agency (FEMA) and the Bureau of Indian Affairs (BIA) to repair and/or refurbish the aquaculture dike.

As with any major flood on the Nooksack River, the 1990 floods carried the possibility of a public health threat to Reservation residents due to the fact that any pollution entrained by floodwaters upstream must pass through or be deposited on the Reservation. Various sources of pollution exist in the floodplain upstream, including dairy waste lagoons, solid waste sites, fuel storage facilities, and wastewater treatment facilities.

Marine Drive, Haxton Way, and Hillaire Road normally provide the only road access to the Lummi Peninsula and Gooseberry Point. During major floods, these transportation routes are inundated by floodwaters, blocking all land access to the peninsula and interrupting the ferry service between Gooseberry Point and Lummi Island. These roads were closed for seven days during the 1989 flood and for ten days during each of the two November 1990 floods. In early 1996 and again during an ice jam on January 1, 1997, west bank levee failures closed these roads for four days. Closure of both roads may also have occurred during the November 1995 and March 1997 floods. Over 2000 people on the Lummi Peninsula and 750 people on Lummi Island would be affected by closure of these roads today (Whatcom County 1997a).

A ferry normally serves Lummi Island with 28 round trips daily from Gooseberry Point, near the southern extent of the Lummi Peninsula upland. However, when flooding blocks road access, the ferry must be diverted to Bellingham, leaving only four or five round trips per day to serve the island and peninsula. Medical emergencies during the road closures must be responded to by helicopter (Whatcom County 1997a).

Because of the proximity of Puget Sound and the Strait of Georgia, flood levels along the lower Nooksack River below Ferndale are influenced by tides. High tides fill the river channel in the delta, which both reduces the channel capacity and raises the level of the fresh water as it flows over the denser salt water. Tidal effects on river discharge can

cause flood flows to overtop levees and/or cause more water to spill over the banks of the river. During the flood on November 10, 1990, these effects raised the flood level at the river mouth several feet higher than what would have happened if the flood occurred several days earlier or later when tidal elevations were lower. Strong southwesterly winds may also have been a factor in this flood by raising the water level in the delta through wave setup (Whatcom County 1995a).

4.2.1.2 Coastal Floods

Coastal flooding in Puget Sound occurs most frequently during the winter months, when the highest tides of the year combine with the storm surge and waves generated by winter windstorms. Several low-lying coastal areas of the Reservation are susceptible to flooding. The areas with the greatest probability of coastal flooding are the Sandy Point Peninsula and the Neptune Beach area in the northwestern part of the Reservation and, to a lesser degree, Gooseberry Point and portions of the southeastern shoreline of the Lummi Peninsula. Several flood events have occurred in all of these areas over the past five years.

The probability and potential damage of flooding along the Sandy Point Peninsula and the Neptune Beach area are greater because they are exposed to a longer reach of open water in the Strait of Georgia (up to a 117-mile fetch from the northwest). Winds blowing from the west to northwest over these longer fetches generate larger waves that, when combined with a high tide and storm surge, overtop the beach berms/dunes in undeveloped areas and the shore defense works in developed areas. The marine waters of the Strait of Georgia then flow onto the lower backshore areas and wetlands that lie in relatively undisturbed areas of the Sandy Point Peninsula and the Neptune Beach area. As shown in Figure 4.6, where owners of shoreline parcels have constructed bulkheads and built houses, this combination of winds, wave build-up, and tides have resulted in substantial property damages due to the force of the wind and waves and due to rocks and logs being thrown against the structures. The flood hazards for the more frequent storms from the south and southwest are smaller because the fetches from these directions are much shorter (up to 10 miles from the southwest for Neptune Beach). The flood hazard from northeast windstorms is less because the eastern shorelines of the Sandy Point Peninsula and the Lummi Peninsula are only exposed to short, shallow-water fetches.

Coastal flooding in the Gooseberry Point area at the south end of the Lummi Peninsula has closed roadways (e.g., Haxton Way and Lummi View Drive) and flooded 15 to 20 homes along the west shoreline. Most recently, coastal flooding at Gooseberry Point occurred during December 2000 and 2001 and January and November of 2003. These homes are exposed to a low to moderate velocity hazard. Along the southeastern shoreline of the Lummi Peninsula, coastal flooding has inundated stretches of Lummi Shore Road and portions of some properties in the Hermosa Beach area that lie landward of the road. Some structures on these properties are flood-prone, though the velocity hazard is low. On January 2, 2003, water flowed over Haxton Way and up to two feet of water pooled around several homes along the Gooseberry Point shoreline. This flood also significantly eroded the shoulder of Lummi Shore Road in the Hermosa Beach area and deposited logs and other debris that blocked the road. Similar but lesser flooding occurred in these areas on November 28, 2003. In these 2003 events, the Lummi Peninsula areas were affected more than the Sandy Point Peninsula, where flooding was slight or did not occur. Figure 4.5 presents photos of the Haxton Way area



(a) Gooseberry Point: Facing views, north from Haxton Way/Lummi View Drive intersection and south from Haxton Way



(b) Hermosa Beach: View north along Lummi Shore Road and west from Lummi Shore Road

Figure 4.5 Flood Effects at Gooseberry Point and Hermosa Beach, January 2, 2003

on Gooseberry Point and of Lummi Shore Road shortly after the flooding occurred in January 2003.

Smaller flooding events along the Sandy Point Peninsula (and probably, on some of these occasions, at the other vulnerable Reservation locations) in the past decade occurred on December 6 – 7, 1995, once in 1996, once in November 2000, on December 14, 2001, on January 2, 2003, and on October 28, 2003. During these smaller storm surge events, water generally overwashed bulkheads, flowed through yards, and deposited beach debris on Sucia Drive, which lies east of the houses that line the west shoreline of the peninsula. Larger, more damaging flood events occurred on March 30, 1975, in December 1982, on December 4, 1993, and on December 15, 2000 (Whatcom County 2001).

The March 1975 flood event caused damage along the Reservation and Whatcom County shorelines, with the greatest damage occurring along the Sandy Point Peninsula. The December 1982 event also affected both Reservation and Whatcom County shorelines, with damage occurring to homes along the Sandy Point Peninsula and at Birch Bay (about eight miles north of the Reservation), where roads and the golf course were also flooded. The 1975 storm was reported to have been the first major windstorm from the northwest since 1948. A major storm on October 12, 1962 (the Columbus Day Storm), generated winds from the southwest with peak gusts of over 100 miles per hour (FEMA 2003c). The 1948 and 1962 storms occurred before substantial residential development along the Sandy Point Peninsula.

On December 4, 1993, sustained winds of 40 to 50 mph, with gusts measured to 59 mph, combined with a high tide to produce large breaking waves that pounded bulkheads and homes along the west shore of the Sandy Point Peninsula and the Neptune Beach area. Waves were estimated to be 10 to 14 feet high and breaking or rising over bulkheads to the second story level of shoreline homes. Entrained logs smashed into bulkheads and through the patio door of one home. Several homes near the south end of the Sandy Point Peninsula (north of the entrance channel) were flooded with water to a depth of more than a foot and several families were evacuated from their homes. The intersection of Sucia Drive and Patos Drive was flooded to a depth of more than two feet and covered with driftwood, isolating the residents to the south. The north end of Sucia Drive was also flooded with several inches of water near the curve onto Beach Way, but remained passable. Damage costs were expected to be thousands of dollars (Sandy Point News Review 1993).

During the December 2000 event, sustained winds of up to 70 mph (Bellingham Herald 2000) generated large waves moving due east, directly into the western Sandy Point/Neptune Beach shoreline along the Strait of Georgia. The high winds combined with a high tide of 10.5 feet (according to the tide tables, the highest tide of 2000 in the Sandy Point area was 10.6 feet) and resulted in wave build-up and in waves crashing into and rising an estimated 10- to 20-feet over the bulkheads lining the Sandy Point Peninsula shoreline. The battering by these waves and associated logs and beach cobbles, which continued for three to four hours during the tide peak, damaged or destroyed bulkheads and eroded properties behind the bulkheads. Many homes suffered water damage, some with a layer of beach cobbles and gravel covering their floors. Several homes had debris (e.g., logs and a large chunk of cement) hurled into them, breaking windows, doors, and walls. A field survey of the 35 homes immediately north of the marina entrance channel (near the south end of the Sandy Point Peninsula)

found the following damage: six failed bulkheads; seven damaged bulkheads; 18 bulkheads with settled rip-rap; six flooded houses; nine damaged houses; 16 destroyed decks; and all 35 properties were flooded and contained overwash debris (Johannessen 2000a). A total of approximately 60 homes/properties along the Sandy Point Peninsula and Neptune Beach had some damage. Residents said the damage from this storm, estimated to be a 15- to 25-year event, was slightly worse than that of the 1975 or 1982 storms (Whatcom County 2001). The total cost of damages from this flood was estimated as approximately \$750,000 (Whatcom County 2002). Photographs of the damage to some homes are shown in Figure 4.6.

4.2.2 Flood Vulnerability Assessment

The vulnerability of the Reservation to riverine and coastal flooding is described in the following two sections. Figure 4.7 shows the estimated vulnerabilities to flooding in the six assessment areas on the Reservation. Table 4.2 summarizes the vulnerability to flood damage and potential losses to areas and structures on the Reservation.

4.2.2.1 Nooksack River Floods

The total assessed value of 30 fee land properties totaling 1,212 acres on the Reservation in the Nooksack River floodplain is about \$1.96 million, or approximately \$1,620 per acre. These 30 fee properties contain at least six residential structures and several farm structures. Assessed values of the approximately 3,500 floodplain acres under individual trust or tribal ownership are not available. However, if these lands are assumed to have an assessed value similar to the fee lands in the floodplain (i.e., approximately \$1,620 per acre), the value of these properties would be approximately \$5.67 million. It is noted that assessed values are generally less than the appraised/replacement values of structures and property. There are approximately 15 residential structures on individual-owned trust properties in the Nooksack River floodplain. In addition, the Lummi Nation owns a Shell gas station/mini-mart at the corner of Haxton Way and Slater Road and the adjacent Silver Reef Casino in the floodplain. Both of these structures comply with the Lummi Nation Flood Damage Prevention Code (Title 15A) and are constructed so that the elevation of the lowest floor is at least one foot above the base flood elevation.

The main physical effects of large Nooksack River floods on the Reservation are damage to flood control structures and residences, erosion of agricultural areas and roads, deposition of sediment and pollutants, and closure of roads. The isolation of the Lummi Peninsula has a large impact on public health and safety since the only remaining transportation is by boat or helicopter. The small ferry serving Lummi Island from Gooseberry Point is diverted from Lummi Island to provide transportation to Bellingham, but with only four round trips each day, capacity is low. Although the Lummi Law and Order and Fire District 8 stations are on the peninsula, extra support for emergency situations is not available in a timely manner during flood-induced road closures. Medical emergencies needing immediate transportation would require a helicopter.

The closure of roads also has a large economic effect on the community since the Lummi Peninsula is essentially isolated. Because many employees cannot get to work, this isolation affects tribal government offices, the health clinic, tribal schools, Northwest Indian College, and some of the small businesses on the peninsula. In addition, many

9th to 12th Houses North of Marina Channel Entrance (View East)



Destroyed Bulkhead and Deck (Several Hours after Peak Waves)



Figure 4.6 Storm Damage along Sandy Point, December 15, 2000

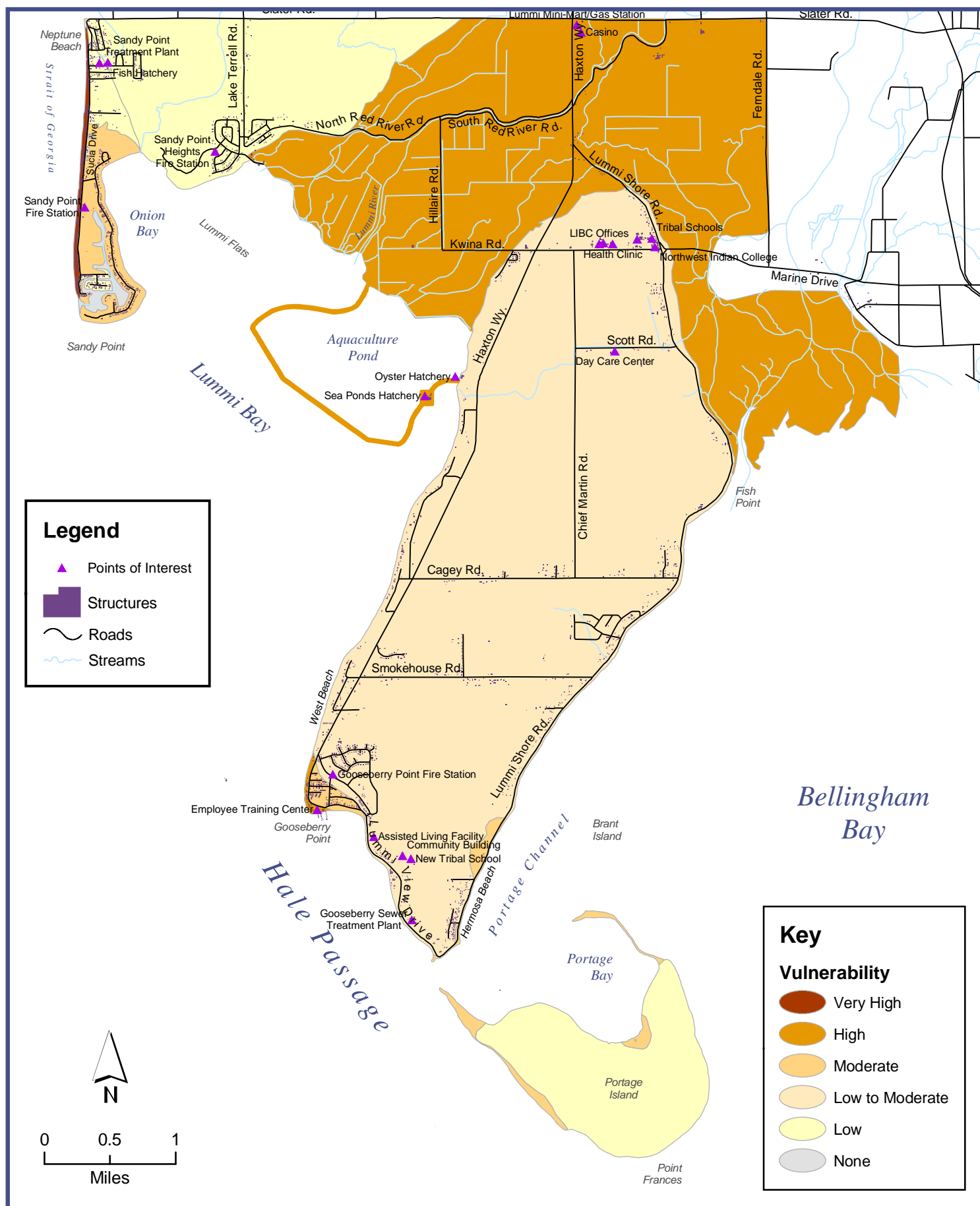


Figure 4.7 Estimated Flood Vulnerabilities in Reservation Areas

residents of the peninsula lose income because they cannot get to work. The Lummi Mini-Mart and the Silver Reef Casino would be affected by both the inability of employees to get to work and by the potential complete loss of business.

4.2.2.2 Coastal Floods

The primary vulnerability to coastal floods on the Reservation is damage to residential buildings, shore defenses, and roads. There are 160 residential properties along the western Sandy Point Peninsula shoreline on the Strait of Georgia. Many of these properties have bulkheads, decks, and/or homes located in the velocity zone on the 2004 final FIRMs (Maps No. 53073C1155D and No. 53073C1165D). A velocity zone is a high hazard area because of the potential for wave action and storm surges. In 2000, these 160 properties had a total assessed value (i.e., assessed value of the structure and property) of \$29,440,715, or an average of \$192,423 per property. Most of the structures on these properties are vulnerable to a 100-year flood event. This vulnerability could be increasing because the beach along the western shoreline of the Sandy Point Peninsula has been eroding and has become steeper in front of the now nearly continuous line of bulkheads (Johannessen 2000b, 2003). A steeper beach allows more wave energy to reach the bulkheads, without being dissipated by a gradual wave run-up. In addition, the vertical bulkheads direct the wave energy upward, which results in higher base flood elevations in this area than along natural beach slopes (FEMA 2003c).

On the eastern and southern shoreline of the Sandy Point Peninsula along Lummi Bay, there are 140 residential properties with a 2000 total assessed value of \$15,767,595, or an average of \$114,258 per property. These properties are exposed to a fetch that is substantially shorter than that of the western shoreline (up to 1.6 miles from the east and 2.9 miles from the southeast across shallow Lummi Bay and up to 8.3 miles from the southwest across the Strait of Georgia). Hence the velocity hazard is less and most of the structures are not as vulnerable to structural damage during a 100-year flood event. However, if homes on these properties are not elevated above the base flood elevation (BFE) identified on the FIRM, they will be subject to shallow flooding during a 100-year coastal flood event.

In the interior area of the Sandy Point Peninsula that is adjacent to the excavated marina canal, there are approximately 202 residences or properties with a 2000 total assessed value of \$25,449,045, or an average of \$125,985 per property. There is also one fire station on the east side of Sucia Drive. This area is identified as a shallow flooding zone on the 2004 final FIRM for Sandy Point. If structures on these properties are not elevated above the BFE, they will be subject to shallow flooding during a 100-year coastal flood event.

In the Gooseberry Point area of the Lummi Peninsula, the Lummi Nation Employment Training Center (a large building holding various offices and a computer lab), the Fisherman's Cove gas station/mini-mart, warehouses, a pier, two boat launch facilities, the Lummi Island ferry terminal, and approximately 92 homes are in the 100-year flood hazard area. In the Hermosa Beach area along the southeastern shoreline of the Lummi Peninsula, four homes are in the 100-year flood area and an approximately 1.5-mile stretch of Lummi Shore Road (LSR) is susceptible to flooding and damage from waves and erosion (as occurred most recently in January and November 2003). Some of the road shoulders damaged in January 2003 were part of the LSR project, a major shore

and bluff stabilization project designed to protect Lummi Shore Road and landward properties from further coastal erosion. (The LSR project is described further in Sections 4.6 and 4.9.)

The Portage Island assessment area has low-lying shoreline areas that have a moderate vulnerability to coastal floods. Uplands of the Sandy Point Peninsula, Northwest Upland, and Portage Island areas that are outside flood zones are assigned a low flood vulnerability (Figure 4.7) to account for the inconvenience of road closures and the potential economic impacts of floods.

A factor to consider for coastal floods is the threat posed by the rise in global sea level that has resulted from warming of the global climate. Global sea level has already risen by four to eight inches in the past century and models suggest this increase will accelerate. The best estimate is that sea level will rise by an additional 19 inches by 2100, with an uncertainty range of 5 to 37 inches (NAST 2000). Since the rate of uplift or subsidence of the Reservation appears to be negligible (Shipman 1989), any rise in sea level will likely result in an equal rise of flood levels in coastal areas on the Reservation.

4.2.3 Potential Flood Losses

Table 4.2 lists the flood vulnerability levels present in each assessment area, the number of structures that are located in each vulnerability level within an area, and the potential structure and contents losses to floods. The Portage Island assessment area is not listed in Table 4.2 because it is currently undeveloped.

4.2.3.1 Nooksack River Floods

The Corps estimated an average annual flood damage cost of \$2.5 million (1992 dollars) for the Nooksack River floodplain, including the three forks of the river (Corps 1993). For the area downstream of Ferndale to the mouth of the river, not including the Marietta community, the estimated annual damage cost was \$475,000 (1992 dollars). Most of the costs below Ferndale are due to damaged flood control facilities and agricultural areas (Corps 1993). As shown in Table 4.2, a major event resulting in losses totaling half of all structure and contents values in the Floodplain assessment area of the Lummi Reservation would cost over \$11 million (2003 dollars).

The economic costs on the Reservation of lost business and lost wages would add substantially to the costs cited by the Corps in 1993. The Silver Reef Casino and Shell gas station and mini-mart would lose all customers during a large flood that closes Slater Road and Haxton Way north of the Lummi River. These two businesses, owned by the Lummi Nation, have combined average daily wages of \$16,327; average daily income exceeds this figure (Mace 2003). The LIBC and other tribal entities on the Lummi Peninsula, many of whose employees live off the Lummi Peninsula, have a daily payroll of approximately \$58,000 (Brown and Brown 2003). Many other residents on the peninsula would not be able to get to jobs off the Reservation.

Table 4.2 Vulnerability and Potential Losses of Structures to Floods

Assessment Area	Estimated Vulnerability	Number of Structures ¹	Structure Losses ²	Contents Losses ³	Location/Comment
Sandy Point Peninsula	Very High	243	\$6,373,000	\$3,186,500	<ul style="list-style-type: none"> Western shoreline is highly vulnerable
	Moderate	325	\$8,896,000	\$4,448,000	<ul style="list-style-type: none"> Eastern and southern shorelines are lower vulnerability Interior of peninsula has low to moderate vulnerability
	Low	181	n/a	n/a	<ul style="list-style-type: none"> Road detours are potential inconvenience Sea level rise would increase hazard
Northwest Upland	Low	285	n/a	n/a	<ul style="list-style-type: none"> Road detours are potential inconvenience
Floodplain (Seaponds Dike)	High	67	\$6,786,750 ⁴	\$4,201,400 ⁴	<ul style="list-style-type: none"> Several homes raised after 1990
	Moderate	7	\$405,000	\$140,800	<ul style="list-style-type: none"> Seaponds Hatchery buildings on aquaculture dike; dike itself has high vulnerability to storm waves and failure of the Lummi Bay seawall
Lummi Peninsula	Moderate	4	\$120,000	\$60,000	<ul style="list-style-type: none"> Hermosa Beach area
	Low to Moderate	1,103	n/a	n/a	<ul style="list-style-type: none"> Isolation due to closed roads - public safety threat Economic impacts on employers and employees
Gooseberry Point	High	43	\$4,381,580	\$794,765	<ul style="list-style-type: none"> 20 homes along western shore, plus outbuildings LIBC mini-mart, office building, pier, and fish processing plant/buying station on southern shore
	Moderate	138	\$1,486,415	\$736,233	<ul style="list-style-type: none"> Interior homes, outbuildings, and warehouses
Total		2,396	\$28,448,745	\$13,567,698	<ul style="list-style-type: none"> Total Flood Losses: ~\$42,016,000

¹Residences, outbuildings, and other structures counted from GIS layer of all structures identified on 1998 aerial photos.

²Potential structure losses estimated as half of 2003 assessed improvements (if area is primarily fee land), estimated residential replacement value (if area is mixed fee and trust land), and/or insured values (see Table 4.19 for specific values).

³Potential contents losses estimated as half of the insured contents values or half of the estimated structure losses (FEMA 2001a).

⁴Silver Reef Casino accounts for 59 and 73 percent of the Floodplain structure and contents values, although its first floor is above the 100-year flood level.

4.2.3.2 Coastal Floods

Given the current vulnerability of the Sandy Point Peninsula and the possibility of substantial sea level rise, an extreme flood event in this area could result in a total loss of many of the structures on the peninsula. As shown in Table 4.2, a major event resulting in losses totaling half of all structure and contents values on the peninsula would cost nearly \$23 million in year 2003 dollars. Comparable losses and damages to structures in the Gooseberry Point area would total over \$7 million. Additional costs would result from the displacement of people from their homes while repairs occurred to make them habitable again.

Because a detailed study that determines potential losses to residential, commercial, and critical facilities has not been completed, potential structure losses for the assessment areas were estimated as half of the 2003 assessed values for improvements (if the area is primarily fee land), the estimated residential replacement value (if area is mixed fee and trust land), and/or insured values (used for public buildings). No assessed values are available for trust lands (as they are not subject to property taxes), so the potential losses for trust lands were estimated to be the same as for fee lands. Potential contents losses were estimated as half of the insured contents values or half of the estimated structure losses. This method has limited accuracy for estimating potential losses because depth of flooding for each structure in the flood areas was not determined. In addition, assessed values are typically less than appraised/market values, which would be used for the acquisition or replacement of structures in hazard areas.

4.3 EARTHQUAKES

Oral histories and geological records show that the Reservation region has a history of large earthquake events. An earthquake is ground shaking that is caused by the sudden release of slowly accumulated pressure within the crust of the Earth or within the tectonic plates below the crust. The movement of tectonic plates towards each other (convergence) generates this pressure. The Pacific Northwest is located above a convergent plate boundary, where the Juan de Fuca and North American tectonic plates meet. This boundary is called the Cascadia Subduction Zone, and it extends from British Columbia to northern California (GSC 2002a).

While earthquakes along this zone occur infrequently, plate movement can produce major earthquakes. In addition, the Puget Sound and Strait of Georgia region is underlain by a large and complex system of faults that can produce damaging earthquakes; these smaller faults produce lower magnitude events, but their ground shaking can be strong and can cause substantial damage to nearby structures. Earthquakes can trigger other geologic and soils failures that contribute to total damages. While surface fault rupture can produce damage to facilities and infrastructure astride the fault, such damage is generally less overall than the damage resulting from strong ground shaking and associated ground failures. These ground failures include landslides and slope failures, lateral spreading and slumping, and liquefaction of soils (Oregon 2000b; GSC 2002a).

Ground shaking, landslides, liquefaction, and amplification are the primary specific hazards associated with earthquakes. The severity of these hazards depends on several factors, including soil and slope conditions, proximity to the fault, earthquake

magnitude, and the type of earthquake (Oregon 2000b; Clackamas County 2002). These four hazards are described below (Oregon 2000b):

- Ground shaking is the motion caused by seismic waves generated by an earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter. Buildings on poorly consolidated and thick soils will typically have more damage than buildings on consolidated soils and bedrock.
- Earthquake-induced landslides are secondary earthquake hazards that result from ground shaking. They can destroy homes and the roads, buildings, utilities, and other critical facilities necessary to respond and recover from an earthquake. Most vulnerable are developed areas with steep slopes, which occur on the Reservation above Neptune Beach and along the east and west shores of the Lummi Peninsula.
- Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. Liquefaction results in the loss of soil strength and the ability of the soil to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures. Areas vulnerable to liquefaction on the Reservation include the Sandy Point Peninsula, Gooseberry Point, and the riverine floodplain. Although stone columns were used to minimize the liquefaction potential at the Silver Reef Casino, such protective measures have not been taken for other structures in these areas.
- Soils and soft sedimentary rocks near the earth surface can modify ground shaking caused by earthquakes. One of these modifications is amplification. Amplification increases the magnitude of the seismic waves generated by the earthquake. The amount of amplification is influenced by the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk. Amplification can also occur in areas with deep, sediment-filled basins and on ridge tops.

The sizes of earthquakes are commonly measured using the Richter magnitude scale, a mathematical tool developed in 1935 to compare earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distances between the various seismographs that record the event and the epicenter of the earthquake. On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude of 5.3 might be computed for a moderate earthquake, and a strong earthquake might have a magnitude of 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude (i.e., magnitude 8 is 100 times greater than magnitude 6); as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the lower number (USGS 2003a).

The Richter Scale is not used to express damage. An earthquake in a densely populated area that results in many deaths and considerable damage may have the same magnitude as an earthquake in a remote area that does no damage. Large magnitude earthquakes that occur beneath the oceans may not even be felt by humans.

Recently, another scale called the moment magnitude scale has been devised for more precise study of great earthquakes. Further discussion of this scale and other measurements of earthquake movement and intensity is provided in Section 4.3.2.

Most large earthquakes in the Pacific Northwest are shallow crustal, deep intraplate, or subduction zone (megathrust) earthquakes. These three types of earthquakes are summarized in Table 4.3.

Table 4.3 Types of Earthquakes in the Pacific Northwest¹

Type	Depth	Frequency (Return Period)	Location of Epicenter	Comment
Crustal	Relatively shallow (6-12 miles)	Magnitude < 4: many per year Magnitude > 6: decades or more apart	Many faults in the region, including two that pass within a few miles of the Reservation	<ul style="list-style-type: none"> • Most common, but usually mild • Potentially Mag. 7 • Potentially near Reservation • Aftershocks common
Intraplate	Relatively deep (25-40 miles)	Decades apart	Anywhere in the region (western Washington, western British Columbia, or Cascade Mtns.)	<ul style="list-style-type: none"> • Potentially Mag. 7.5 • Potentially near Reservation • Few or no aftershocks • Nisqually Earthquake
Subduction Zone, or Megathrust	Intermediate depth	500 years, on average (200 to 1,000 years apart)	Most likely under the ocean off the Pacific Coast	<ul style="list-style-type: none"> • Potentially Mag. 9+ • Not close to Reservation • A minute or more of strong shaking • Large aftershocks

¹ Clackamas County 2002; Geological Survey of Canada [GSC] 2002a, 2002b

Geologic evidence shows that the Cascadia Subduction Zone has generated great megathrust earthquakes, most recently about 300 years ago. This Cascadia megathrust earthquake is thought to have been magnitude 9 or greater (like recorded megathrust earthquakes in other regions, including the 1964 southern Alaska earthquake that measured magnitude 9.2). The average recurrence interval of these large Cascadia earthquakes is approximately 500 years, with gaps between events as small as 200 years and as large as 1,000 years. The evidence indicates that 13 great earthquakes have occurred in the Pacific Northwest over the last 6,000 years and a similar offshore event can be expected to happen sometime in the future. Such earthquakes may cause substantial damage to the coastal areas of the region, and they represent a considerable hazard to those who live in the Puget Sound region. However, because the fault is offshore, it is not the greatest earthquake hazard faced by this region (GSC 2002a).

In the interval between megathrust earthquakes, the tectonic plates become stuck together, yet continue to move towards each other. This causes tremendous strain and deformation of the crust of the Earth in the coastal region, which results in ongoing earthquake activity. The Puget Sound region is now in such an interval. Some of these onshore crustal or intraplate earthquakes can be quite large (there have been four magnitude-7+ earthquakes in the past 130 years in southwest British Columbia and

northern Washington State). Because these inland earthquakes occur more frequently and can be much closer to the Reservation, they represent the largest earthquake hazard to the Lummi Nation (GSC 2002a).

Shallow crustal earthquakes are the most common earthquakes, but are usually relatively mild. However, two faults pass within a few miles of the Reservation, and four crustal earthquakes with magnitudes between five and six have been recorded within approximately 10 to 20 miles of the Reservation (Table 4.4). Deep intraplate earthquakes occur in the subducting oceanic crust and can reach up to magnitude 7.5. The Nisqually Earthquake on February 28, 2001, in Washington State was a deep intraplate earthquake that had a magnitude of 6.8. It produced a rolling motion that was felt from Vancouver, British Columbia to Coos Bay, Oregon and east to Salt Lake City, Utah. A 1965 magnitude-6.5 intraplate earthquake centered south of Seattle-Tacoma International Airport caused seven deaths (USGS 2001a; Clackamas County 2002).

In the following subsections, past earthquake events, earthquake vulnerability, and potential earthquake losses on the Reservation are described.

4.3.1 Profiles of Past Earthquake Events

Many earthquakes occur in the area of the Reservation. Most are too small to feel, but relatively rare large earthquakes could potentially cause massive social, economic, and environmental impacts. Table 4.4 summarizes the largest recorded earthquakes in the region. Figure 4.8 shows the locations of recorded earthquakes in the Reservation area.

The most recent earthquake that affected the Reservation was the magnitude-6.8 Nisqually Earthquake of February 28, 2001. This intraplate earthquake was centered 35 miles southwest of Seattle (or about 120 miles south of the Reservation) and occurred 30 miles underground. It caused one death, hundreds of mostly minor injuries, and estimated total damages of \$2-3.5 billion. President Bush granted federal disaster assistance on March 1, 2001 (FEMA 2001b). The Nisqually Earthquake was easily felt (light to moderate shaking) on the Reservation and caused damage to some buildings in the area as well as subsidence of the Lummi Aquaculture Dike. The FEMA awards for damage to tribal facilities from the Nisqually Earthquake totaled \$128,471 (Bunton 2003). There were additional awards to individuals and possibly businesses. Other intraplate earthquakes occurred on April 13, 1949, near Olympia (magnitude 7.1) and on April 29, 1965, between Seattle and Tacoma (magnitude 6.5).

These intraplate earthquakes caused landslides, liquefaction, and/or other ground failures in the Puget Sound region. The 1949 earthquake probably triggered a landslide three days later at the Tacoma Narrows that produced an 8-foot high tsunami in Puget Sound. The tsunami reflected off of the undeveloped opposite shoreline and caused minor flood damage to homes adjacent to the landslide. The large landslide destroyed the homes in its path (Noson et al. 1988; Walsh 2003). In addition, a large portion of a sandy spit jutting into Puget Sound north of Olympia disappeared during the earthquake (USGS 2001a). These earthquakes may also have produced damage in the Reservation area (Whatcom County 2002).

Table 4.4 Largest Known Earthquakes Capable of Damage on the Reservation¹

Year (Name)	Type	Epicenter (from Reserv.)	Magnitude ²	Comment
2001 Nisqually	Intraplate	~120 miles S (about 11 miles NE of Olympia)	6.8	<ul style="list-style-type: none"> Strong shaking for 40 sec. One death (heart attack) 700+ injuries, four serious \$2-3.5 billion total damage \$128,471 public damage on Reservation (plus private)
1990	Crustal	~20 miles E	5.0	<ul style="list-style-type: none"> Near Deming
1976	Intraplate	~33 miles W	5.1	<ul style="list-style-type: none"> W. of North Pender Island
1967	Crustal (?)	~5-10 miles W	4.1	<ul style="list-style-type: none"> Just off NE shore of Orcas Is.
1965	Intraplate	~105 miles S (near SeaTac Airport)	6.5	<ul style="list-style-type: none"> Seven deaths ~\$12.5 million total damage Landslides, liquefaction, and other ground failures
1964	Crustal (?)	~10 miles NE	5.0	<ul style="list-style-type: none"> Between Ferndale and Lynden
1949	Intraplate	~130 miles S (near Olympia)	7.1	<ul style="list-style-type: none"> Strong shaking for 20 sec. Eight deaths; many injuries ~\$25 million total damage Probable trigger of landslide that caused 8-foot tsunami Other ground failures
1946	?	~125 miles NW (central Vancouver Is.)	7.3	<ul style="list-style-type: none"> Two deaths Many chimneys toppled, buildings damaged Strong shaking on Lummi Reservation
1920	Crustal (?)	~22 miles SW	5.5	<ul style="list-style-type: none"> NW corner of Shaw Island Slight damage in Bellingham, Anacortes, and Victoria, BC
1909	Intraplate (?)	~5-10 miles W	6.0	<ul style="list-style-type: none"> Just off NE shore of Orcas Is. 19 miles deep Slight damage in Blaine, Bellingham, and Anacortes
1896	Crustal (?)	~20 miles S	6.0	<ul style="list-style-type: none"> Decatur Island
1872	Crustal	~60-120 miles E or SE (?)	7.3	<ul style="list-style-type: none"> Largest historic event in WA Damage in Victoria, BC, and Seattle, WA
1700	Megathrst.	~120 miles W	~9	<ul style="list-style-type: none"> Huge tsunami destroyed village on Vancouver Is., caused damage in Japan Evidence of land subsidence
~900	Crustal	~90 miles S (along Seattle Fault)	~7+	<ul style="list-style-type: none"> Massive landslides Tsunami deposits along Puget Sound Land subsidence

¹Noson et al. 1988; Chleborad and Schuster 1990; Atwater and Moore 1992; Engebretson 1996; Whatcom County 2002; Clackamas County 2002; GSC 2002a, 2002b.

²Magnitudes before 1969 are approximate (Engebretson 1996).

Question marks indicate uncertainty regarding the type or location of an earthquake.

(a) Epicenters, dates, and magnitudes of large earthquakes that occurred between 1872 and 2002 in the Puget Sound region. The symbols represent the relative size and depth of the earthquake (PNSN 2003); (b) Major faults in the region (Gower et al. 1985); (c) Local recorded earthquakes and identified faults, with potential extensions indicated by dashed lines (Easterbrook et al. 2000).

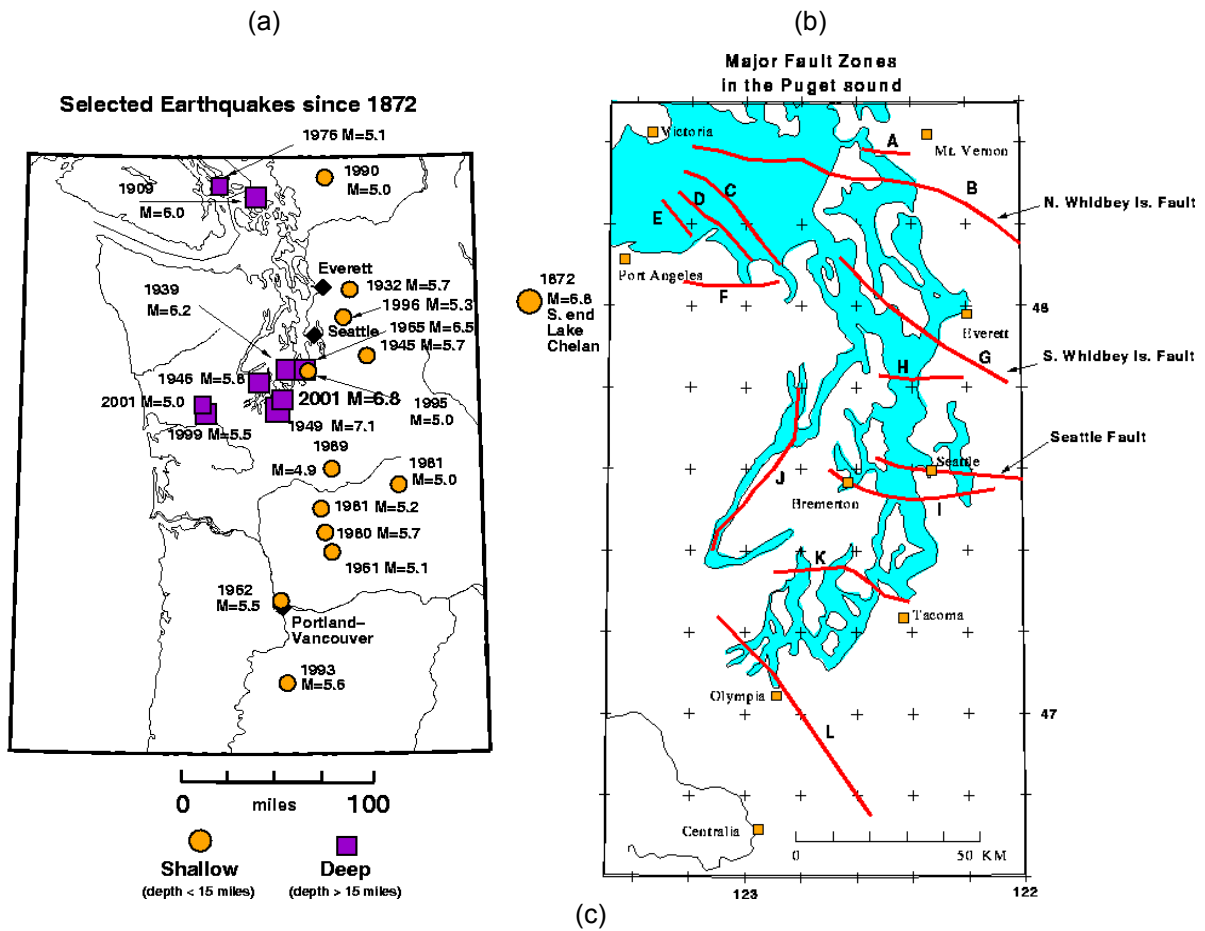


Figure 4.8 Locations of Recorded Earthquakes and Faults in the Reservation Region

Large crustal earthquakes that may have impacted the Reservation include a magnitude-7+ earthquake on the Seattle fault about 1,100 years ago. Probable evidence of this earthquake includes large landslides and tsunami deposits (Atwater and Moore 1992). Other crustal earthquakes include an estimated magnitude-7.3 North Cascades earthquake in 1872 and the magnitude-5 earthquake in 1990 located in Whatcom County near Deming (Whatcom County 2002). During the 1872 earthquake, probably centered between Mt. Baker and Lake Chelan, the shaking was strong enough to frighten people and cause them to run out of buildings in Victoria, New Westminster, and Yale, British Columbia, and in Seattle, Washington. The earthquake was reportedly felt from central British Columbia (Quesnel) to central Oregon (Salem) and east into the present day Alberta and Montana. Occurring today, it would probably cause strong shaking but only slight damage on the Reservation since the epicenter was some distance away (GSC 2002b).

The largest historic onshore earthquake recorded in southwestern British Columbia was a magnitude-7.3 event that occurred in 1946. The epicenter was in central Vancouver Island, just to the west of the communities of Courtenay and Campbell River. This earthquake caused considerable damage on Vancouver Island, and was felt as far away as Portland, Oregon, and Prince Rupert, British Columbia. The earthquake knocked down 75 percent of the chimneys in the closest communities (Cumberland, Union Bay, and Courtenay) and did considerable damage in Comox, Port Alberni, and Powell River (on the eastern side of the Strait of Georgia). A number of chimneys were shaken down in Victoria, and people in Victoria and Vancouver were reportedly frightened. Two deaths resulted from this earthquake, one due to drowning when a small boat capsized in an earthquake-generated wave, and the other from a heart attack in Seattle (GSC 2002c). Occurring today, the shaking on the Lummi Reservation from this earthquake would be strong, or frightening to most people, but the potential damage would probably be only slight (Table 4.6; FEMA 2001a).

The most recent Cascadia Subduction Zone earthquake occurred in 1700 and was estimated as a magnitude 9, which makes it one of the largest recorded earthquakes on Earth. The undersea Cascadia thrust fault ruptured along a 1,000-km length, from the middle of Vancouver Island to northern California, producing tremendous shaking and a huge tsunami that swept across the Pacific. This earthquake was identified through Japanese records of the tsunami, which did considerable damage in Japan. Along the Pacific Northwest coast, it raised some land elevations up to five meters, caused underwater landslides, and caused the subsidence and drowning of coastal old growth trees. Oral traditions of the native peoples of Vancouver Island indicate that the tsunami destroyed a winter village, with no survivors, at Pachena Bay on the west coast of Vancouver Island. The oral traditions also indicate that the shaking damaged houses in the Cowichan Lake region of south central Vancouver Island. The shaking was reportedly so violent that people could not stand, and so prolonged that it made them sick (GSC 2002a).

4.3.2 Earthquake Vulnerability Assessment

The sizes of earthquakes are described using several methods that quantify the magnitude and intensity in different ways. The Richter Scale, described earlier, measures earthquake magnitude using the amplitude of seismograph waves. A more recent logarithmic method, moment magnitude, measures the energy released at the source of the earthquake, and is also determined from measurements on seismographs.

Moment magnitude measurements are thought to describe the strength of large earthquakes more accurately than the Richter Scale (USGS 2003a). The Modified Mercalli Intensity (MMI) measures the strength of shaking produced by an earthquake at a certain location; it is determined from effects on people, human structures, and the natural environment. The MMI value for each earthquake varies from location to location (USGS 2002). Table 4.5 shows the relationship between moment magnitudes and MMI levels of earthquakes, as well as the associated perceived motion and level of damage that are typically observed at locations near the epicenter of an earthquake. Commonly, sites on soft ground or alluvium have intensities two to three units higher on the Modified Mercalli Intensity scale than sites on bedrock. This is important on the Reservation because the floodplains of the Nooksack and Lummi rivers are comprised of alluvium and the remainder of the Reservation uplands are comprised of glacial material.

Table 4.5 Relationship Between Moment Magnitude and Modified Mercalli Intensity¹

Moment Magnitude	Modified Mercalli Intensity	Description of Perceived Motion and Level of Damage Associated with Each Intensity Level
1.0 - 3.0	I	I. Not felt except by a very few people under especially favorable conditions.
3.0 - 3.9	II - III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.
4.0 - 4.9	IV - V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
5.0 - 5.9	VI - VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
6.0 - 6.9	VII - IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
7.0 and higher	VIII or higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level distorted. Objects thrown into the air.

¹ http://neic.usgs.gov/neis/general/handouts/mag_vs_int.html (USGS 2002)

One measure of the strength of earth movement in an earthquake is peak ground acceleration (PGA), which is expressed as a percentage of the force due to gravity (g). For example, a PGA of 20 represents an acceleration equal to 20 percent of the force due to gravity. The PGA is the maximum acceleration of the ground during the course of

the earthquake motion, and is related to the force a building will receive during an earthquake. This force will vary between locations based on the distance from the earthquake epicenter and on the nature of the soils or rock in a location. Table 4.6 shows the correlation between the Modified Mercalli Intensity scale, PGA values, perceived shaking, and potential damage. A PGA of nine to eighteen would be perceived as strong shaking and would potentially result in light overall damage (FEMA 2001a). A PGA of about ten may be the approximate threshold of damage to older (pre-1965) dwellings or dwellings not made to resist earthquakes (USGS 2003b). This value should not be used in the case of particular buildings because (1) the relation between intensity and peak acceleration is quite variable; (2) for more distant sites, longer duration ground motions may cause damage at lower acceleration values; and (3) buildings differ greatly in their vulnerability (USGS 2003b).

Table 4.6 Modified Mercalli Intensity, PGA Equivalents, and Potential Effects¹

MMI	PGA	Perceived Shaking	Potential Damage
IV	1.4 - 3.9	Slight	None
V	3.9 - 9.2	Moderate	Very Slight
VI	9.2 - 18	Strong	Slight
VII	18 - 34	Very Strong	Moderate
VIII	34 - 65	Severe	Moderate to High
IX	65 - 124	Violent	High
X	> 124	Extreme	Very High

¹FEMA 2001a.

The National Seismic Hazard Mapping Project of the United States Geological Survey (USGS) Earthquake Hazards Program indicates that an earthquake producing a PGA ranging from 23.5 to 24.7 on the Lummi Reservation has a ten percent probability of exceedence over 50 years (or an average occurrence of once in 475 years, or approximately a 0.2 percent chance of occurring in any one year). An earthquake producing a PGA ranging from 45.5 to 47.3 has a two percent probability of exceedence over 50 years (an average occurrence of once in 2,476 years, or approximately a 0.04 percent chance per year). For reference, these PGA values are ten to forty percent less than predicted PGA values for earthquakes in the Seattle area with the same recurrence interval and approximately half of the PGA values for two locations in the Oakland area and one location in the Los Angeles area of California, the state with the greatest earthquake vulnerability in the continental United States (USGS 2003b).

The USGS data and the information in Table 4.6 indicate that, since the MMI categories represent a range of PGA values, the chance the Reservation will experience an earthquake that produces very strong shaking and that results in moderate potential damage (i.e., a PGA greater than 18) is somewhat greater than ten percent over 50 years (or more frequent than once in 475 years). Likewise, there is greater than a two percent chance over 50 years (or more frequent than once in 2,476 years) that severe shaking and moderate to heavy potential damage will occur.

It is important to realize that the PGA probabilities described above were calculated using all known potential earthquake sources and all magnitudes for each source that were believed possible in the vicinity of the location (USGS 2001b). An average probability was determined for each magnitude-location pair and the probabilities were added to provide the overall probability for a specific level of ground motion. The

presence of unknown or underestimated earthquake sources would mean the chance of a strong earthquake is greater. The USGS analysis determined that the most likely source for earthquake damage on the Reservation is an earthquake with a moment magnitude of 5.0 to 7.0 within 16 miles of Bellingham (e.g., the 1909 earthquake just northeast of Orcas Island with a magnitude of 6.0 on the Richter scale). Similar earthquakes up to 62 miles from Bellingham and earthquakes of moment magnitudes from 8.0 to 9.0 that are 47 to 78 miles from Bellingham are also significant contributors to the overall PGA probability for the Reservation. In this USGS study, an earthquake with a moment magnitude of 7.0 to 7.5 within 31 to 47 miles of Bellingham contributed less than 0.1 percent to the overall PGA probability for the Reservation; the probability contribution of a magnitude-7+ earthquake within 47 miles of Bellingham was otherwise considered to be zero (USGS 2001b). This information suggests that the possibility of an MMI-IX earthquake with a PGA of between 65 and 124 that produces violent shaking and high potential damage on the Reservation is currently believed to be negligible.

Recent studies indicate that two long-recognized faults, the Vedder Mountain and Sumas faults, are longer and more active than previously thought. These crustal faults extend from British Columbia southwest and possibly pass through and near, respectively, the Reservation. They may connect to identified faults that extend to the northwest along the Canadian San Juan Islands. These faults are likely responsible for many small earthquakes recorded in the Whatcom County area as well as the 1909 and 1964 earthquakes listed in Table 4.4. Their close proximity suggests that they may represent the largest potential source of earthquake hazards on the Reservation (Easterbrook et al., 2000; Federal Energy Regulatory Commission 2002). As such, they may be the most likely source for the earthquakes with a moment magnitude of 5.0 to 7.0 within 16 miles of Bellingham that, as described above, contribute most to the overall PGA probability for the Reservation.

In considering potential damage to structures on the Reservation, it is important to realize that impacts will vary with the local geologic conditions and the extent to which mitigation measures were taken during either construction or retrofitting of structures. Sites and structures on shoreline fill, soft soil, or alluvial deposits, such as the Nooksack River floodplain, Sandy Point Peninsula, and Gooseberry Point shoreline, may experience damage that is one to two categories higher than the average potential damage on the Reservation (FEMA 2001a; Clackamas County 2002). The glacial deposits forming the uplands on the Reservation have a high response to seismic shaking relative to areas of bedrock (Whatcom County 1995b). The level of seismic design incorporated into structures is an important factor to consider in these areas of greater potential vulnerability. Figure 4.9 shows the estimated relative vulnerabilities to earthquakes in the six assessment areas on the Reservation. Table 4.7 lists the estimated vulnerability for structures in the five developed assessment areas. Currently undeveloped Portage Island is not listed in Table 4.7.

4.3.3 Potential Earthquake Losses

The 2001 Nisqually Earthquake recently demonstrated the potential for damage in the Reservation region. According to a FEMA study, the state of Washington ranks second in the nation after California among states susceptible to economic loss caused by earthquake (WEMD 2001). The study predicts an annualized economic loss in Washington of \$228 million due to earthquakes. Seattle is seventh and Tacoma is 22nd on a list of cities with more than \$10 million in annualized earthquake losses. These

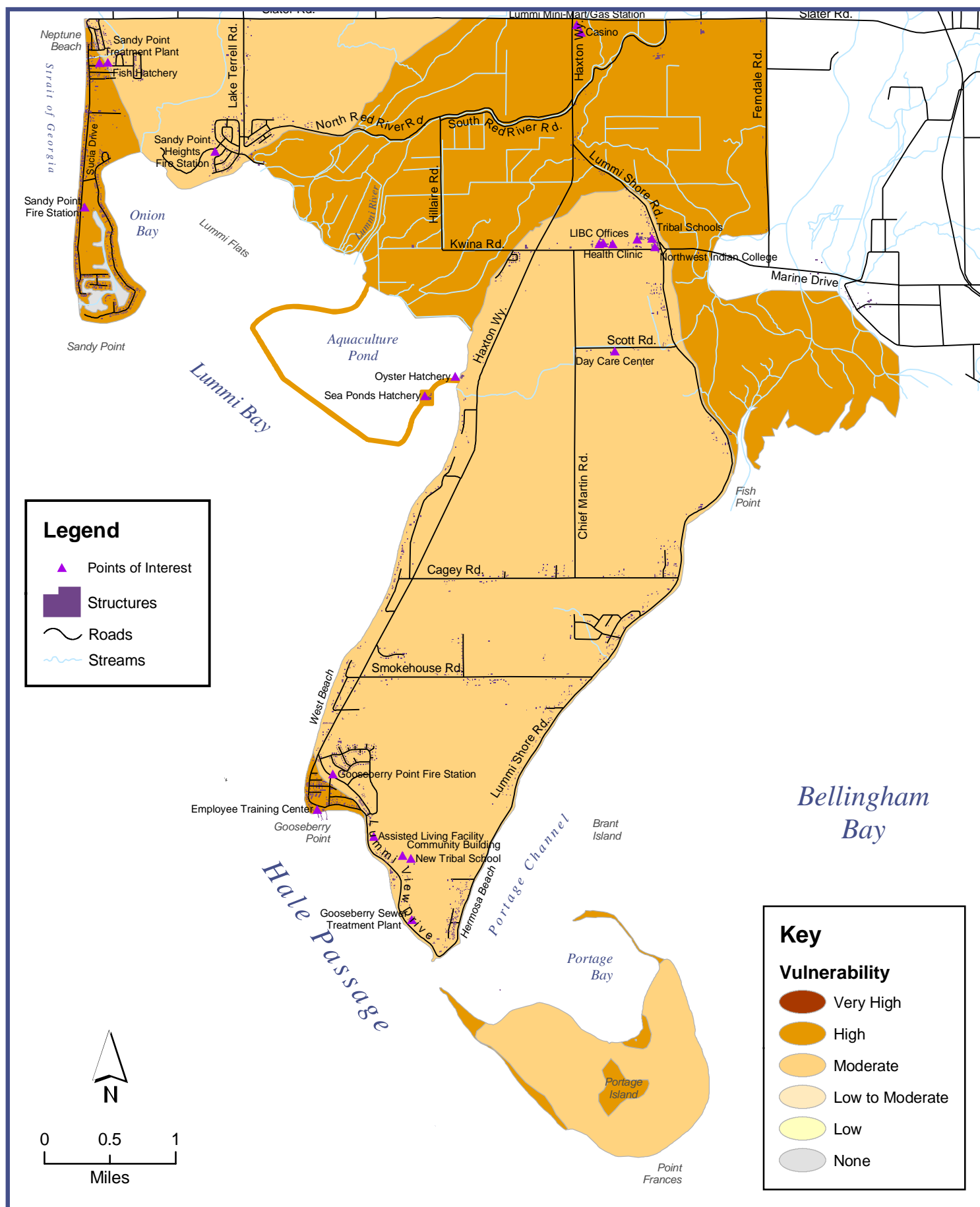


Figure 4.9 Estimated Earthquake Vulnerabilities in Reservation Areas

Table 4.7 Estimated Earthquake Vulnerability of Structures

Assessment Area ¹	Structure(s)	Year Built	Estimated Vulnerability ²	Comment
All (except Portage Island)	Lummi Water District wells, reservoirs, water lines	1964-Present	Moderate	• Pipelines through areas of unconsolidated soils are more vulnerable
	Lummi Sewer District treatment plants, sewer lines, and pump stations	1982-Present	Moderate	• Collection lines, force mains, and pump stations through areas of unconsolidated soils are more vulnerable; • Disruptions to sewer collection and treatment system affects entire Reservation
	Roads	Variable	Moderate	• Roads through areas of unconsolidated soils are more vulnerable
	Electric Lines	Variable	Moderate	• Lines through areas of unconsolidated soils are more vulnerable
	Phone Lines	Variable	Low	• Lines through areas of unconsolidated soils are more vulnerable
Sandy Point Peninsula	Sandy Point Fire Station	1998	Moderate	• Enhanced shaking and liquefaction possible in alluvial deposits
	Lummi Sewer District Wastewater Treatment Plant	1982	Moderate to High	• Enhanced shaking possible in alluvial deposits
	Residences	1962-Present	Moderate to High	• Enhanced shaking and liquefaction possible in alluvial deposits; • Many homes before 1976
Northwest Upland	Sandy Point Heights Fire Station	1980s	Low	• Enhanced shaking possible in Bellingham Drift soils
	Lummi Natural Resources Pump House, Tank	1994	Low	• Enhanced shaking possible in Bellingham Drift soils
	Residences	Pre-1950-Present	Low to Moderate	• Variable age and seismic design of structures; • Approximately half of homes before 1976; • Enhanced shaking possible in Bellingham Drift soils
Floodplain	Silver Reef Casino	2001	Low	• Enhanced seismic design, including foundation columns extending 20 feet below the ground
	Shell Gas Station and Mini-Mart	1998	Moderate	• Enhanced shaking and liquefaction possible in alluvial deposits; • Fuel lines possible source of leaks; automatic shut-off valve; • Fuel tanks are double wall fiberglass, with approved leak detectors and monitors and meeting all EPA regulations; • Merchandise on shelves exposed
	Lummi Bay Seaponds Fish Hatchery	1972	Moderate to High	• Enhanced shaking and liquefaction possible
	Residences	Pre-1950-Present	Moderate to High	• Enhanced shaking and liquefaction possible; • Mostly agricultural land use; relatively few homes

¹ Portage Island is not listed because it is currently unoccupied and undeveloped.

² Estimated based on underlying soil, year built/seismic design, and type of construction.

Table 4.7 Estimated Earthquake Vulnerability of Structures

Assessment Area ¹	Structure(s)	Year Built	Estimated Vulnerability ²	Comment
Lummi Peninsula	Lummi Sewer District Wastewater Treatment Plant	1982	Moderate	<ul style="list-style-type: none"> Enhanced shaking possible in Bellingham Drift soils
	Gooseberry Point Fire Station	1963	Low	<ul style="list-style-type: none"> Enhanced shaking possible in Bellingham Drift soils
	Wex li em Community Center	1995	Low	<ul style="list-style-type: none"> Large timber-frame structure
	Little Bear Creek Senior Assisted Living Facility	2000	Low	<ul style="list-style-type: none"> Large wood-frame structure; Vulnerable population
	Headstart Classroom Building	2000	Low	<ul style="list-style-type: none"> Newer wood-frame structure
	Tribal School	~1970+	Moderate	<ul style="list-style-type: none"> Mostly modular buildings built since 1990; cinder block gymnasium built in ~1970; Enhanced shaking possible in terrace deposits; Existing tribal school due to be replaced by new structure in 2004
	Northwest Indian College	1950s-2001	Moderate	<ul style="list-style-type: none"> Mostly ~1980s modular buildings with wood-frame construction, block foundations; four buildings from 1950s; one in 1989 & 2001 Enhanced shaking possible in terrace deposits
	Lummi Tribal Health Center	2000	Low	<ul style="list-style-type: none"> Newer wood-frame structure
	LIBC Offices	1950s/1990+	Moderate	<ul style="list-style-type: none"> Primarily wood-frame and some cinder block construction from 1950s and since ~1990; Enhanced shaking possible in terrace deposits
	LIBC Archives Building	1998	Low	<ul style="list-style-type: none"> Newer wood-frame structure
	Tribal Courthouse	2003	Low	<ul style="list-style-type: none"> Newer wood-frame structure
	Lummi Shellfish Hatchery	1972	Moderate	<ul style="list-style-type: none"> Older structures may not meet current seismic standards; Enhanced shaking possible in unconsolidated alluvial deposits
Gooseberry Point	Residences	Pre-1950-Present	Low to Moderate	<ul style="list-style-type: none"> Variable age and seismic design of structures; Many homes built before 1976
	LIBC Employment Training Center	1950s	Moderate to High	<ul style="list-style-type: none"> Enhanced shaking and liquefaction possible; Older building, may not meet current seismic standards
	Fisherman's Cove Marina (gas station, mini-mart)	1950s	Moderate to High	<ul style="list-style-type: none"> Enhanced shaking and liquefaction possible; Fuel lines possible source of leaks; automatic shut-off valve; Fuel tanks are double wall fiberglass, with approved leak detectors and monitors and meeting all EPA regulations; Older building, may not meet current seismic standards; Merchandise on shelves exposed
	Fisherman's Cove (boat storage, launching, and repair)	1950s	Moderate to High	<ul style="list-style-type: none"> Enhanced shaking and liquefaction possible; Older structures, may not meet current seismic standards
	Residences	Pre-1950-Present	Moderate to High	<ul style="list-style-type: none"> Enhanced shaking and liquefaction possible; Most homes before 1976

economic losses in the Reservation region will have direct and indirect effects on the residents and businesses of the Reservation.

An accurate dollar estimation of building losses due to earthquake on the Reservation would require building information such as date of construction, type of building, seismic design at date of construction, and assessed values of buildings, as well as information on the earthquake hazard. Some of this information may not be available for the Reservation and such a detailed study, even using the Hazards-U.S. (HAZUS) software developed by FEMA, is beyond the scope of this plan.

Approximate losses estimated by HAZUS (1999 version) were provided by the Washington Emergency Management Division using default data from the 1990 Census (Quarles 2003). The estimated annualized losses on the Reservation due to structural damage (\$9,000), nonstructural damage (\$41,000), and contents damage (\$15,000) totaled \$65,000 (estimated inventory loss was zero). These estimated losses to structures and contents represented a loss ratio of 0.04 percent (evidently based on an outdated total value for structures and contents of \$162.5 million). Based on the figures listed in Table 4.19, the total structure and contents value of all private residences (assessed or estimated values) and public facilities (insured values) on the Reservation is over \$248 million. Annualized losses based on this figure and a loss ratio of 0.04 percent indicate a total annualized loss of approximately \$99,000 for structures and their contents. Since the newer structures contributing to this larger estimate of structure values are less vulnerable than older structures, the total annualized loss is likely lower than \$99,000. However, private businesses have not been included in this inventory. Since residential structures represented 92 percent of structure value on the Reservation in this HAZUS analysis (Quarles 2003), residences accounted for the majority of damages. Unreinforced masonry structures were estimated to represent 0.6 percent of the structure inventory. The estimated annualized income losses (due to relocation, capital-related, wage, and rental income losses) on the Reservation totaled \$9,000. With annualized total damages of \$74,000, these figures suggest that over 50 years the probable damages would total \$3.7 million.

For a specific, moment magnitude-7.1 earthquake on the South Whidbey Island fault with a PGA on the Reservation of 8.4, the HAZUS program estimated the following probabilities for damage to structures:

- None: 89 percent
- Slight: 8 percent
- Moderate: 3 percent
- Extensive: Less than one percent
- Complete: Zero

As described in Section 4.3.2, an earthquake generating a PGA on the Reservation greater than 8.4 will occur someday, but its probability is much lower than this modeled event. An updated HAZUS-MH (Multi-Hazard) version may show similar slight damages on the Reservation since structures built since 1990 should be resistant to earthquake damage. However, if the estimated earthquake hazard has increased, damage may be proportionally larger.

The majority of the buildings on the Reservation were built in the past three decades, when seismic design requirements were in place, and are unlikely to suffer significant

damage during the most probable earthquakes. Of the buildings built before seismic design requirements were in place, most are single story, and only a few, if any, brick or block buildings have a second story. Thus, the probability of deaths or serious injuries resulting from the collapse of buildings is low, especially given the low probability of a severe earthquake causing heavy damage. Buildings with unreinforced, weight-bearing brick walls constructed with sand-lime mortar are most vulnerable. Older multistory buildings may be moderately vulnerable, while the performance of wood frame dwellings should be excellent, based on experience in recent earthquakes (WEMD 2001). The estimated structure and contents values for buildings on the Reservation are listed in Section 4.12.

The approximately 430+ residential buildings built before 1975 are likely to suffer some damage in a strong or very strong earthquake. Many of the LIBC offices, current tribal school and NWIC buildings, and older small business buildings are also likely to suffer damage in a strong or very strong earthquake. The Nisqually Earthquake, with moderate perceived shaking on the Reservation, resulted in damages totaling \$54,607 to LIBC buildings (Bunton 2003). The cost of repairing the Lummi Aquaculture dike was \$73,864. Additional FEMA awards for Nisqually Earthquake damage were made to residents on the Reservation.

Other structures that are vulnerable to amplification and liquefaction along the Reservation and nearby shorelines also represent potential earthquake losses. These structures include the Fisherman's Cove piers; the Whatcom County ferry terminal pier at Gooseberry Point; bulkheads, sea walls, and dikes along the shoreline; sewer and water pipelines; and the Cherry Point refinery piers for oil tankers, just north of the Reservation. Damage to these structures, including potential spills from fuel or sewer tanks and pipelines, would result in environmental, economic, and potential public health and safety effects on the Reservation.

Public health and safety, environmental, and economic effects would also result from potential electrical powerline, water pipeline, and sewer pipeline failures. The power poles and pipelines on the Reservation are vulnerable to amplification and, in the Sandy Point Peninsula, Gooseberry Point, and Floodplain assessment areas, possibly liquefaction. Overhead power lines could slap against each other and cause short circuits. Downed electrical lines would result in short- or long-term loss of power, which would result in economic losses and could result in environmental or public health and safety hazards. Sewer lines that rely on electrical pump stations will not function during power outages. Pipelines that are gravity systems could be affected by changes in grade or by flotation caused by liquefaction. Water lines that fail and drain can not be used to provide water for fire suppression, drinking, sanitation, and other uses.

In a large future earthquake, the Lummi Nation would also suffer economic losses from regional damages. Road transportation on the Reservation is heavily dependent on bridges that cross the Nooksack River. These bridges are vulnerable to amplification and liquefaction of the river sediments that support the bridge columns. The disruption of transportation resulting from damaged bridges would have economic and public health and safety effects on the Reservation. In addition to potential transportation effects, disruption of economic activity and damages to other infrastructure in the region will have direct and indirect economic effects on the Reservation and its residents.

4.4 SEVERE WINTER STORMS

Winter storm hazards include heavy snows, ice storms, and extreme cold. Like most other natural hazards, heavy snow can immobilize a region and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulation of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days. The cost of snow removal, repairing damages, and loss of business can have large economic impacts. Similarly, heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. In addition, ice jams may form on rivers and in storm sewer systems and lead to flooding. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Extreme cold often accompanies a winter storm or is left in its wake. Prolonged exposure to the cold can cause frostbite or hypothermia and become life-threatening (NOAA 1991).

In this section, past winter storm events, winter storm vulnerability, and potential winter storm losses on the Reservation are described.

4.4.1 Profiles of Past Winter Storm Events

A blizzard is defined as sustained wind or frequent gusts to 35 mph or greater and considerable falling and/or blowing snow that frequently reduces visibility to less than a quarter-mile. The Reservation region is one of only two areas within Washington State that the National Weather Service recognizes as having a blizzard potential (WEMD 2001). Nearly every winter, outflows of very cold arctic air move south down the Fraser River valley in Canada and push into the Whatcom County area, often moving directly onto the Reservation. The cold air is usually accompanied by strong northeast winds that can topple trees and disrupt power. The strong winds also can result in a dangerous wind chill effect. When the cold arctic air flowing from the north meets warm moist air from the south, snow can result, sometimes with significant accumulations. Table 4.8 lists the major recorded winter storms that have affected the Reservation.

Table 4.8 Recorded Major Winter Storm Events in the Reservation Region¹

Date	Storm Type	Description
December 26, 1996	Winter storm, wind, gale warning, flood, landslide, and avalanche	Storm fronts pushed across Washington, causing structures to collapse under the heavy weight of snow, road closures, power outages, landslides, and 20 weather-related deaths. The Governor declared emergencies for 37 counties. Federal Disaster Number 1159 was issued for the storm.
November 19, 1996	Ice storm	In the Puget Sound area 50,000 customers were without power. There were 4 deaths and \$22 million in damages. Federal Disaster Number 1152 was issued for the storm.
1990	Winter storm	Two arctic storms, snow, high winds, thaw and refreeze, and floods on the Reservation.
January 1950	Snowstorm and wind	Blizzard dumped 21 inches of snow on Seattle and killed 13 people in the Puget Sound region. The snowfall was accompanied by 25-40 mph winds. The winter of 1949-50 was the coldest recorded in Seattle with average temperatures of 34.4 degrees. January had 18 days with high temperatures of 32 degrees or lower.

Table 4.8 Recorded Major Winter Storm Events in the Reservation Region¹

Date	Storm Type	Description
February 1, 1916	Snowstorm and wind	Twenty-one inches of snow fell in Seattle in 24 hours and 2 to 4 feet in other parts of Western Washington. In January and February, Seattle received 58 inches of snow. Winds created snowdrifts as high as five feet.

¹WEMD 2001; Whatcom County 2002.

During the 1996-97 winter storms, high snowfall and cold temperatures resulted in significant snow accumulations. The accumulations, aggravated by rain, drifting snow, and ice in roof drains, caused excessive weight and the collapse of structures. Roughly 70 residents on the Reservation received disaster assistance from FEMA to fix damaged roofs; the LIBC also received funding to repair roofs of tribal buildings (Folsom 2003). Over 400 boats in the Puget Sound region sank due to the collapse of covered marina slips. High winds and ice contributed to the repeated and extended power outages that involved over 500,000 power customers during December 1996 - February 1997 (WEMD 2001).

4.4.2 Winter Storm Vulnerability Assessment

Relative to the size of the Reservation, winter storms are a large-scale event. Hence, all six assessment areas of the Reservation are exposed to severe winter storms to a similar degree. However, some differences exist in the vulnerabilities of the six areas to winter storms. One difference is that the relatively unforested Sandy Point Peninsula, Gooseberry Point, and Floodplain areas are exposed to somewhat greater wind speeds and wind chill effects. The forested areas of the Reservation face the hazard of branches breaking under the weight of snow and ice. In addition, there are numerous slopes in the Lummi Peninsula and Northwest Upland areas that can be difficult to drive if the roads have not been plowed and sanded. One factor that increases the relative vulnerability of the Floodplain assessment area is flooding from the Nooksack River caused by an ice dam forming in the river. Finally, the Floodplain area and the north- or east-facing areas of the Reservation (including portions of the Northwest Upland and Portage Island and the eastern-facing side of the Lummi Peninsula) are more exposed to the cold northeast winds from the Fraser Valley. Based on this greater exposure, these areas were estimated to have a high vulnerability to winter storms; the remainder of the Reservation is estimated to have a moderate vulnerability to winter storms. The estimated vulnerabilities to winter storms of the six assessment areas and critical facilities on the Reservation are shown in Figure 4.10.

Since snow and freezing temperatures are irregular events on the Reservation, they can catch residents off-guard and less prepared than if such weather occurred on a regular basis. This factor makes the Reservation more vulnerable than colder regions in that homes may be less protected and residents less accustomed to traveling in snow and ice conditions. Older homes and facilities on the Reservation are likely more vulnerable to freezing or the burden of heavy snow than newer structures.

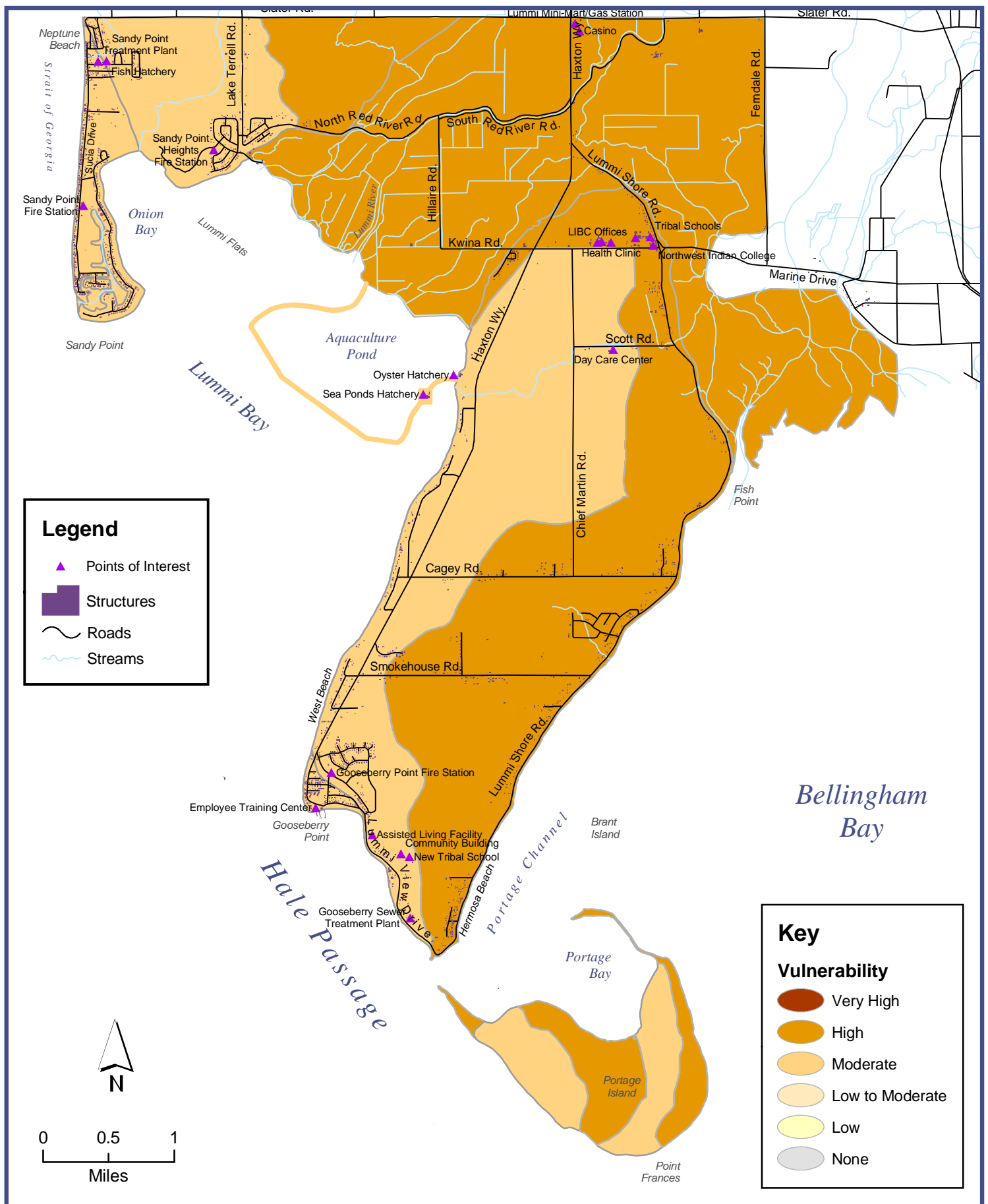


Figure 4.10 Estimated Winter Storm Vulnerabilities in Reservation Areas

The overall vulnerability of the Reservation to winter storms is moderate to high. These events present a significant hazard to public health and safety and a substantial disruption of economic activity, but a limited and infrequent hazard to structures. The generally short duration of winter storm effects also limits the vulnerability of the Reservation. The probability of occurrence is high since winter storms with smaller effects occur approximately every other year, while storms with larger effects occur less often.

4.4.3 Potential Winter Storm Losses

It is difficult to estimate the cost of potential storm damages to structures on the Reservation. Damage to roofs by heavy snow accumulations depends on the quality of construction and the weight of the snow. Frozen water pipes will also result in a certain amount of damage. Storm water drains that become blocked by ice could lead to damage due to local flooding. Any number of these factors could combine at various degrees of severity to produce the total structural damages that may result from a winter storm.

Recovery from winter storms often requires assistance from emergency responders from utilities, public works, firefighting, emergency medical services, search and rescue, law enforcement, and the Coast Guard. The costs of these services can quickly add up for the governments that provide them and the governments may not have a sufficient reserve in place to cover the costs.

Utility lines could be broken by heavy accumulations of ice, causing power outages or loss of phone lines. These outages are usually small in geographic area, but the outage duration can be extended – particularly in relatively rural areas. Severe or lengthy cold periods require more electric power, which may be in short supply. Extended outages may require shelters to be opened, particularly in very cold weather.

The economic losses caused by a winter storm may frequently be greater than structural damages. Employees may not be able to get to work for several days, customers will stay at home, offices and businesses may not open, and damages will result in the cost of repairs and the cost of lost business while repairs occur. The Lummi tribal offices and schools are commonly closed after a winter storm because of icy roads. Depending on the size, duration, and timing of a winter storm, economic costs could be substantial. Overall, winter storms may occasionally result in significant human, economic, and property losses on the Reservation.

4.5 WINDSTORMS

Similar to severe winter storms, windstorms can disrupt vital electric power and telephone systems, threaten lives and property, and typically do tremendous damage to forests, both rural and urban. Windstorms on the Reservation can occur at any time of the year, but are most common from October to March. When winds are from the north or south, channeling or funneling of strong winds by Vancouver Island and the San Juan islands can increase wind speeds in the vicinity of the Reservation (Whatcom County 2002). In this section, past windstorm events, windstorm vulnerability, and potential windstorm losses on the Reservation are described.

4.5.1 Profiles of Past Windstorm Events

The Columbus Day Storm of 1962 was the strongest, most widespread, non-tropical windstorm to strike the continental United States in recorded history, affecting an area from northern California to British Columbia. The storm claimed seven lives in Washington State; 46 died throughout the affected region. One million homes lost power. More than 50,000 homes were damaged. Total property damage in the region was estimated at \$235 million (1962 dollars). The storm blew down 15 billion board feet of timber worth \$750 million (1962 dollars), which is more than three times the timber blown down by the May 1980 eruption of Mount St. Helens and enough wood to replace every home in the state (Hill et al. 1999). The highest recorded wind speeds (before the power went out at recording stations) were (Hill et al. 1999):

- Naselle, Washington Coast: gust to 160 mph.
- Portland, Oregon: gust of 119 mph.
- Bellingham and Vancouver: gusts of 92 mph.
- Renton, Washington: gust of 100 mph.
- Tacoma, Washington: gust of 88 mph.

The local effects of the Columbus Day Windstorm were (Whatcom County 2002):

- Sank the Lummi Island ferry Chief Kwina.
- The Bellingham Airport reported 75 mph winds and gusts to 98 mph;
- Power wires flashed;
- Windows exploded from changes in pressure;
- Rural areas took the brunt of the storm: barns, sheds, roofs, and silos collapsed throughout the county; dead cattle, trees, and debris were strewn about;
- Louis Auto Glass building in Bellingham collapsed under 98 mph wind;
- Some roofs ripped away;
- The Sumas Bus Garage was wrecked; and
- Damage was reported at Western Washington University, Battersby Field, Lowell Elementary School, and the Pioneer Rest Home in Ferndale.

Another large windstorm occurred on the morning of January 20, 1993, when a powerful low pressure system swept through central Western Washington and caused great destruction, numerous injuries, and five deaths. This storm is commonly referred to as the Inaugural Day Storm since it occurred on the day of the Presidential Inauguration. Winds averaging 50 mph caused trees to fall and knocked out power to 965,000 customers. Hurricane force winds swept King, Lewis, Mason, Pierce, Snohomish, Thurston, and Wahkiakum counties. Winds in the Puget Sound area gusted to 60-70 mph. A gust at Cape Disappointment on the Washington Coast reached 98 mph. Throughout the Puget Sound region, fifty-two single-family homes, mobile homes, and apartment units were destroyed, and 249 incurred major damage, many from falling trees and limbs. More than 580 businesses were damaged. Total damage in western Washington was estimated at \$130 million (WEMD 2001; Hill et al. 1999).

Summaries of major recorded windstorm events in the region are provided in Table 4.9.

Table 4.9 Recorded Windstorm Events in the Reservation Region¹

Date	Description
December 2001	Similar but less severe conditions to the December 2000 storm produced damage along the Sandy Point Peninsula on the Lummi Reservation.
December 2000	Severe damage (~\$750,000) to beachfront homes along the Sandy Point Peninsula of the Reservation resulted from waves/flooding generated by a combination of gale force northwest winds, extreme high tides, storm surge, and low pressure.
October 27, 1999	A strong Pacific frontal system moved across western Washington, causing power and phone outages throughout the region. Marine storm and coastal flood warnings were issued for the coast. One citizen died when a tree fell on them.
March 3, 1999	Sustained winds of 40 mph were generated in the region, with one gust recorded at 129 mph. The Coast Guard recommended that all marine vessels report to safe moorage.
November 19, 1998	Winds of 80 miles per hour were recorded in the region, toppling trees and causing power outages to 15,000 customers.
October 29, 1997	Commercial fishing vessel Miss Lindsay, 53-feet long, overturned at night and four fishermen drowned in Hale Passage/Bellingham Bay in storm-force winds of 58-81 mph out of SE and 5- to 6-foot seas. Miss Lindsay was discovered capsized on October 30, 1997, in Bellingham Bay, 0.1 nautical mile SE of Portage Island.
December 1995	Storms starting in California generated winds of 100 miles per hour, continued north, causing three states, including Washington, to issue disaster proclamations. Federal Disaster Number 1079 was issued for the incident.
December 4, 1993	Sustained winds of 40 to 50 mph combined with a high tide to produce large breaking waves that caused damage to bulkheads and homes along the Sandy Point Peninsula of the Reservation.
January 20, 1993	Inauguration Day Storm damaged homes, businesses, and public utilities, leaving thousands without power for days from Longview to Bellingham. The state Emergency Operations Center coordinated resources. The National Guard provided generator power and equipment. The Energy Office prioritized power restoration. The American Red Cross sheltered 600 people and fed 3,200 meals. The Department of Transportation and the State Patrol coordinated transportation routes and road closures. Federal Disaster Number 981 was assigned for the event.
September 1986	Commercial fishing boat swamped at Gooseberry Point on the Reservation and sank at the dock. High winds and five-foot waves washed over the dock. Lummi Island Ferry closed, leaving 18 school children that commuted from Lummi Island without a way home.
December 1982	Flooding, severe storm, high winds, and coastal flooding affected the Reservation and Whatcom County areas. Four persons were injured, 122 people were evacuated, 129 homes and 113 businesses were damaged, and there was \$1.7 million in Stafford Act assistance for public facility damage. In addition, the U.S. Small Business Administration loaned \$1 million to home and business owners for damages. Federal Disaster No. 676 was declared for the Whatcom County area (Washington State Department of Emergency Services et al., 1983).
February 25, 1979	Worse local electrical power damage than Columbus Day Storm of 1962 because the winds of 25-30 mph did not let up. It interrupted power to 4,000 customers in Whatcom County, especially widespread outages at Chuckanut, Birch Bay, Custer, Nooksack, Sumas, and near Lake Louise. Most damage was by trees breaking lines. Hood Canal Bridge near Port Gamble, Washington, destroyed by windstorm.
February 13, 1979	Winds up to 70 mph knocked out power on Lummi Island, Larrabee, Chuckanut Drive, Highway 9 from Wickersham to Mount Baker Highway, and from Marine Drive (possibly including the Reservation) to Lynden in northern Whatcom County.
March 30, 1975	Windstorm from the northwest caused flood damage along the Reservation and Whatcom County shorelines, with the greatest damage occurring along the Sandy Point Peninsula.

Table 4.9 Recorded Windstorm Events in the Reservation Region¹

Date	Description
October 12, 1962	The Columbus Day Storm is considered the greatest windstorm to hit the Northwest in recorded history. It was the top weather-related event (including floods, winter storms, and all other climatic events) in Washington during the 20 th Century, according to the National Weather Service, Seattle Forecast Office. Federal Disaster No. 137 was assigned for the event.
November 1958	High winds in Western Washington.
November 7, 1940	Tacoma Narrows Bridge collapsed due to induced vibrations from 40 mph winds.

¹WEMD 2001; Whatcom County 2002, FEMA 2003c.

4.5.2 Windstorm Vulnerability Assessment

Windstorms with sustained winds of 50 miles per hour are powerful enough to cause significant damage and occur frequently in the Puget Sound area (WEMD 2001). In a large windstorm, the six assessment areas of the Reservation are exposed to comparable wind speeds, but the vulnerability varies because of the differences in hazards between these areas. Many of the buildings in the Lummi Peninsula and Northwest Upland areas are close to trees that could be blown onto the buildings, an obvious hazard to personal safety as well as the structures. Roads in these two areas are also more likely to be blocked by fallen trees. Areas of denser development, such as Gooseberry Point, Sandy Point Heights, and the Sandy Point Peninsula, may face a greater hazard from fallen power lines relative to less developed areas. The hazard of direct damage to structures, such as damaged roofs, should be similar in the six assessment areas, with total damages proportional to the number of structures. Wind-driven waves present a hazard of coastal flooding in the shoreline areas, especially along the Sandy Point Peninsula and to a lesser degree at Gooseberry Point, Hermosa Beach, and Portage Island (see Section 4.2 for details). These waves also generate much of the coastal erosion described in Section 4.6. The estimated vulnerability of the six assessment areas and critical facilities on the Reservation is shown in Figure 4.11. Forested areas and coastal flood zones were estimated to have high wind vulnerability and non-forested areas were estimated to have moderate vulnerability to windstorms.

4.5.3 Potential Windstorm Losses

The potential losses to structures in the five developed assessment areas from a major wind event are summarized in Table 4.10. The damages due to downed trees or direct wind effects for this hypothetical event are defined as 50 percent destruction of five percent of vulnerable buildings (adjacent to trees) and destruction of roofs on an additional five percent of buildings (requiring roof replacement). Average estimated costs for replacement of the damaged structures were used to calculate total figures. The costs of other losses, such as downed utility lines, loss of power, economic and governmental disruption, electrocution, and danger of fire, are difficult to accurately estimate and are not included in the estimated potential losses. Loss of power also results in a disruption of sewer pump operations, which increases the possibility of environmental damage and public health risks from overflows of sewage.

It is important to note that the majority of the coastal flooding that occurs along the Reservation shorelines is caused by wind-generated waves, that is, the damage from

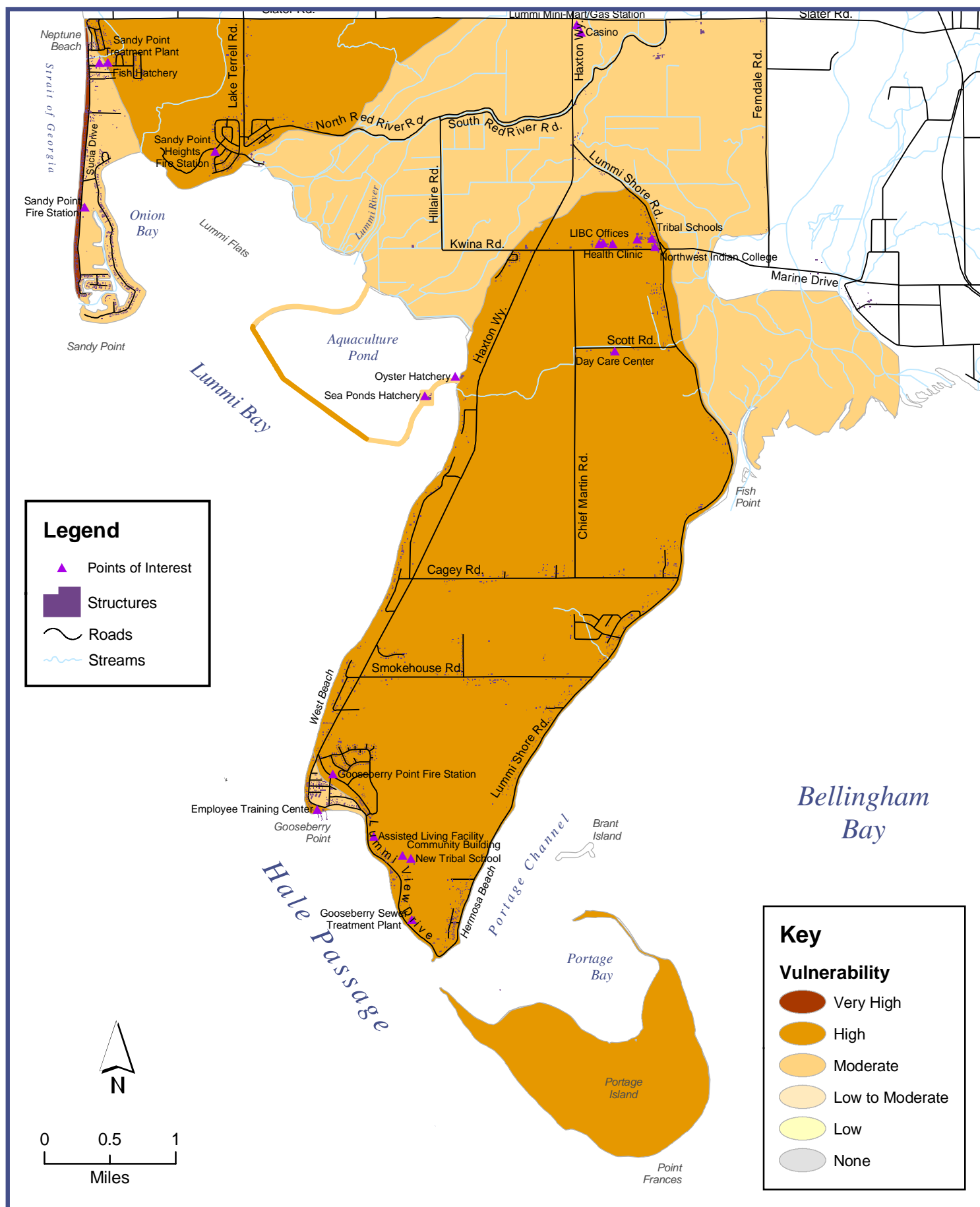


Figure 4.11 Estimated Windstorm Vulnerabilities in Reservation Areas

Table 4.10 Vulnerability and Potential Losses of Structures to Windstorms

Assessment Area	Estimated Vulnerability	Direct Wind or Tree Blowdown Damage			Coastal Flood Damage (from Table 4.2)			Location/Comment
		Number of Structures ¹	Structure Losses ²	Roof Losses ³	Number of Structures ¹	Structure Losses ⁴	Contents Losses ⁵	
Sandy Point Peninsula	Very High				243	\$6,373,000	\$3,186,500	▪ Western shoreline
	Moderate				325	\$8,896,000	\$4,448,000	▪ Southern and eastern shorelines and interior of peninsula
		749	\$0	\$92,500				▪ Mostly unforested, direct wind damage for entire peninsula;
Northwest Upland	High	285	\$367,658	\$35,000				▪ Most of the area is forested
Floodplain	High				1	n/a	n/a	▪ Seaponds dike
	Moderate	74	\$0	\$10,000	7	\$405,000	\$140,800	▪ Seaponds Hatchery buildings ▪ Most of the area is not forested
Lummi Peninsula	High	1,107	\$1,516,500	\$137,500				▪ Most of the area is forested, but public facility surroundings are mostly cleared
	Moderate				4	\$120,000	\$60,000	▪ Hermosa Beach
Gooseberry Point	High				43	\$4,381,580	\$794,765	▪ Western and southern shoreline
	Moderate	181	\$0	\$22,500	138	\$1,486,415	\$736,233	▪ Interior area ▪ Most of the area is not forested
Total		2,396	\$1,884,158	\$297,500	761	\$21,661,995	\$9,366,298	▪ Total Windstorm Losses: ~\$33,209,951

¹Residences and other structures counted from GIS layer of all structures identified on 1998 aerial photos. Total structures does not include utility lines.

²Potential structure losses due to tree blowdown are estimated replacement cost (see Table 4.19 for specific values) of 50 percent of structure for five percent of structures in high vulnerability areas.

³Potential roof losses due to direct wind damage are estimated replacement cost of roof (\$2,500) for five percent of structures in all vulnerability areas.

⁴Potential structure losses estimated as half of 2003 assessed improvements (if area is primarily fee land), estimated residential replacement value (if area is mixed fee and trust land), and/or insured values (see Table 4.19 for specific values).

⁵Potential contents losses estimated as half of the insured contents values or half of the estimated structure losses (FEMA 2001a).

such flooding is largely due to windstorms in combination with high tides. As described in Section 4.2, windstorms from certain directions, when combined with high tide conditions, can result in coastal flooding along exposed shoreline areas. The aspect of each shoreline area, as well as the timing of the windstorm, determines whether an area is vulnerable to flooding during a specific windstorm. Thus the estimated potential losses due to coastal flooding that are listed in Table 4.2 can also be attributed to windstorms and are therefore also listed in Table 4.10. Although these flooding losses will depend on wind direction and tidal timing, the potential losses due to downed trees or direct wind effects are not dependent on wind direction or time of day and therefore could occur during any strong windstorm (although downed trees are more likely during the wet season when saturated soils are softer).

4.6 COASTAL EROSION

Erosion is the general process or group of processes whereby earth materials are loosened, dissolved, or worn away and simultaneously moved from one place to another (Bates and Jackson 1980). Coastal erosion is a chronic hazard along some of the Reservation shorelines. The processes involved may be wave action, storm surge, elevated El Niño sea level, nearshore currents, tidal effects, and even subsidence due to Cascadia Subduction Zone earthquakes or other geologic processes. Physical factors that affect erosion rates include sediment sources; changes in relative sea level; sediment size, density, and shape; sand-sharing of beaches, dunes, and offshore bars; effects of waves, currents, tides, and wind; offshore bathymetry; and shore defense works. Often more than one of these factors will occur at once to put property in peril. Human influences can include alteration of the beach, dunes, or bluffs; dredging; construction of groins and jetties; hardening shorelines with seawalls or revetments; and beach nourishment. Coastal erosion can also lead to collateral damage such as flooding, bluff recession, and landslides (Oregon 2000b).

In this section, past coastal erosion events, coastal erosion vulnerability, and potential coastal erosion losses on the Reservation are described.

4.6.1 Profiles of Past Coastal Erosion Events

A beach alteration that affected erosion on the Sandy Point Peninsula was the excavation of the Sandy Point Marina entrance channel in 1958 (a project that was completed without a permit from the U.S. Army Corps of Engineers or any other permit). This excavation interrupted the historic southward littoral drift of sediment along the west shore of the Sandy Point Peninsula. Instead of accreting on the South Cape of the peninsula, the sediment is now deposited in the entrance channel and will eventually fill the channel. Without the historic flow of sediment from the north, the formerly accreting South Cape has been eroding at a relatively high rate. The measured erosion rates along South Cape range up to nearly three feet per year over the 1982 to 2002 period. The shoreline adjacent to the north side of the marina entrance has also been eroding at a high rate, ranging from approximately four to five feet per year over the 1962 to 1982 period. Over these same periods, the spit extending from the north side of the marina entrance has been growing from approximately nine to nearly twelve feet per year (Johannessen 2003).

Although coastal erosion is largely a storm-driven process, its effects are generally only noticed over the long term as storm waves whittle away at beaches and coastal bluffs.

However, specific erosion events occur on occasion, causing immediate damage by eroding the support of structures that were built close to the shore. Although such damage may occur during a specific storm, all such damage on the Reservation has resulted from the gradual, long-term process of erosion (Johannessen 2000c). Two recent events occurred on the Reservation along the Sandy Point Peninsula in December 2000 and along Lummi Shore Road (LSR) in January 2003. These events were described in detail in Section 4.2.1.2 on coastal flooding and are summarized with other recorded erosion processes below in Table 4.11. Figure 4.12 presents photographs of the erosion damage along LSR in January 2003. Photographs of erosion effects along the west beaches of the Sandy Point and Lummi peninsulas are shown in Figures 4.6 and 4.16, respectively.

Table 4.11 Recorded Coastal Erosion Events on the Reservation

Date	Description
January 2003	<ul style="list-style-type: none"> ▪ Southerly winds generated waves that flooded the Lummi Peninsula shoreline at Gooseberry Point and Hermosa Beach. ▪ The shoulder along approximately 1.5 miles of Lummi Shore Road was eroded in several sections, undercutting but not damaging the road surface in a few short sections.
December 2000	<ul style="list-style-type: none"> ▪ A high tide and strong northwesterly winds drove large waves into the west shore of the Sandy Point Peninsula. ▪ The waves eroded sediments supporting bulkheads and decks as well as material behind bulkheads. The damage included six failed bulkheads; seven damaged bulkheads; 18 bulkheads with settled rip-rap; six flooded houses; nine damaged houses; 16 destroyed decks; and all 35 properties surveyed were flooded and contained overwash debris (Johannessen 2000a).
December 1997	<ul style="list-style-type: none"> ▪ A coastal storm eroded the bank along Lummi View Drive, causing a large portion of the road shoulder to fall down to the beach. A 150-foot section of a force sewer line, the primary collector line from the west side of the peninsula, was nearly exposed and very vulnerable to further erosion. Emergency placement of a shore-armoring revetment was conducted to protect the road.
1990s-Present	<ul style="list-style-type: none"> ▪ Erosion along Lummi View Drive on the Lummi Peninsula is threatening the road. A project to relocate the road away from the bluff is scheduled for completion during 2004.
1990s-Present	<ul style="list-style-type: none"> ▪ Erosion along West Beach on the Lummi Peninsula is threatening homes near the edge of the bluff. One home was moved inland in 2002.
1990s-1998	<ul style="list-style-type: none"> ▪ Coastal erosion severely damaged Lummi Shore Road, causing dangerous driving conditions due to the undercut roadway, which was reduced to one lane in ten locations. ▪ Erosion threatened utilities that parallel the road, including a water main, sewer force main, sewer gravity lines, sewer pump stations, and power and communications lines. ▪ An estimated 8,600 cubic yards eroded per year from the bluffs along Lummi Shore Road. ▪ In December 1994, an emergency rock revetment project was completed by the U.S. Army Corps of Engineers to protect approximately 2,500 feet of shoreline along Lummi Shore Road. ▪ In December 1998, approximately 9,400 linear feet of additional rock revetment was installed along Lummi Shore Road by the Corps of Engineers. Associated beach nourishment activity is on-going.



(a) View south along Lummi Shore Road in the Hermosa Beach area



(b) View north along Lummi Shore Road in the Hermosa Beach area

Figure 4.12 Erosion Damage along Lummi Shore Road, January 2003

4.6.2 Coastal Erosion Vulnerability Assessment

As described above in Table 4.11, several coastal areas on the Reservation are vulnerable to erosion. The entire shoreline of the Reservation is currently the subject of on-going monitoring and analysis of coastal erosion by Coastal Geologic Services, Inc., using the best available data for each reach of shoreline. Rates of erosion or accretion were determined from periods that represent current shoreline conditions so that the rates will predict future shoreline change more accurately. These periods were chosen based on the development history of each reach, literature-based assessment of shoreline processes, and the availability of high-resolution land and shoreline surveys. Although this analysis quantified rates of shoreline change, a qualitative assessment of the relative current and predicted future rates of change was also made (Johannesson 2003). This qualitative assessment is presented in Figure 4.13, which shows that the relative vulnerability to coastal erosion varies in sometimes short stretches. This variation is due to differing exposure of the shoreline reaches to wave action as well as the factors mentioned in the beginning of this section. In Figure 4.13, a high level of vulnerability is associated with erosion rates greater than 0.4 ft/yr, and a moderate level of vulnerability is associated with erosion rates less than or equal to 0.4 ft/yr. Reaches of negligible erosion, accretion, or mixed erosion and accretion are associated with a low level of vulnerability.

4.6.3 Potential Coastal Erosion Losses

One estimate of potential erosion losses is provided by the benefits derived from a project designed to prevent coastal erosion. The total benefits gained from the Lummi Shore Road project (slope revetment, road improvements, and drainage improvements) were calculated to be \$742,600 per year (in 1997 dollars), 99 percent of which was associated with the avoided future cost of relocating the roads and utilities away from the eroding bluff. With average annual costs of \$636,000, the project had a benefit-to-cost ratio of 1.2 (Corps of Engineers 1997). Phase One of this project, completed in December 1998, protected 9,400 feet of Lummi Shore Road with a rock revetment on the slope below the road. Phase Two of this project, which is scheduled for completion during 2004, will improve existing shore defense works or place new shore defense works along approximately 1,900 linear feet of shoreline and relocate approximately 0.6 miles of Lummi View Drive away from the shoreline.

Along the Sandy Point Peninsula, the west shore and South Cape have high erosion rates that, over time, either have damaged or threaten damage to the structures along the shore. Continued erosion will make this area more vulnerable to coastal flooding in the future. Erosion of the toe of the bluff above West Beach on the Lummi Peninsula is increasing the landslide hazard along this shoreline reach (see Section 4.9). A similar process is threatening a stretch of Lummi View Drive near the southern tip of the Lummi Peninsula. Continued erosion and a lack of mitigation actions could eventually lead to the complete loss of the threatened structures. These potential total losses for the five developed assessment areas are estimated in Table 4.12.

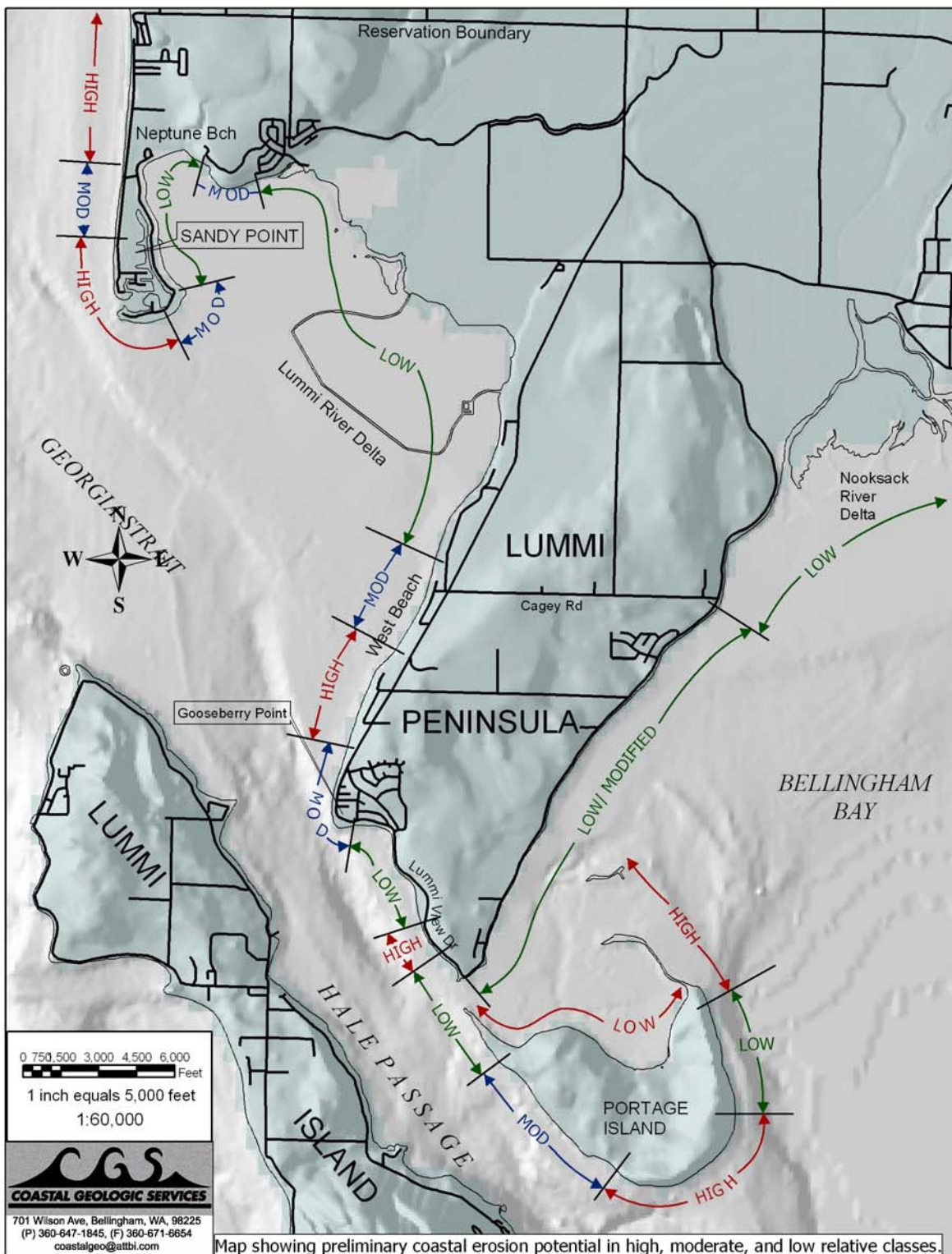


Figure 4.13 Relative Coastal Erosion Vulnerabilities along Reservation Shorelines
 (Johannessen 2003)

Table 4.12 Vulnerability and Potential Losses of Structures to Coastal Erosion

Assessment Area	Estimated Vulnerability	Number of Structures ¹	Structure Losses ²	Contents Losses ³	Location/Comment
Sandy Point Peninsula	Moderate to High	255	\$13,704,000	\$6,852,000	▪ West and south shore
Northwest Upland	Moderate	0	n/a	n/a	▪ No structures near eroding shoreline
Floodplain	Low	1	n/a	n/a	▪ Although erosion rate is low, Seaponds dike is vulnerable to storm waves
Lummi Peninsula	Moderate to High	60	\$4,980,540	\$2,490,270	▪ West Beach and portion of Lummi View Drive
Gooseberry Point	Moderate	43	\$8,763,160	\$1,589,530	▪ 20 homes along western shore, plus outbuildings ▪ LIBC mini-mart, office building, and piers
Total		359	\$27,447,700	\$10,931,800	▪ Total Erosion Loss: ~\$38,379,500

¹Residences, outbuildings, and other structures counted from GIS layer of all structures identified on 1998 aerial photos. For the Lummi Peninsula, the number of structures was determined from 2003 assessed improvements.

²Potential structure losses estimated as 100 percent of 2003 assessed improvements (if area is primarily fee land), estimated residential replacement value (if area is mixed fee and trust land), and/or insured values (see Table 4.19 for specific values).

³Potential contents losses estimated as 100 percent of insured values or 50 percent of structure losses (FEMA 2001a).

4.7 DROUGHT

Drought is a condition of dryness that is severe enough to reduce soil moisture, water, and snow levels below the minimum necessary for sustaining plant, animal, and economic systems. A drought results from a long period of abnormally low precipitation. The severity of a drought depends upon the degree and duration of low precipitation and the size of the affected area. Droughts are a natural part of the climate cycle. Unlike most disasters, droughts normally occur slowly but last a long time. In the past century, the Pacific Northwest has experienced many drought episodes, including several that lasted for more than a single season (e.g., 1928-32, 1992-94, and 1996-97). The most severe Washington State droughts on record occurred in 1977 and 2001 (WEMD 2001).

Depending upon its severity, a drought can have a widespread impact on the environment and the economy. The economic impacts of drought occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts. The National Drought Mitigation Center groups the likely direct impacts of drought into three categories (National Drought Mitigation Center 2003):

- Agricultural – Crops that rely on natural precipitation are threatened.
- Water supply – Supplies for irrigated agriculture and water systems are threatened.
- Fire hazard – Threat of wildfires from dry conditions is increased.

In every drought, agriculture is adversely affected, especially in non-irrigated areas. Droughts affect individuals (farm owners, tenants, and farm laborers), the agricultural industry, and other agriculture-related sectors. Lack of snow during some droughts has forced ski resorts into bankruptcy. There is increased danger of forest fires; millions of

board feet of timber have been lost to fire during drought periods. The loss of trees and other vegetation during wildfires increases erosion, causing serious damage to aquatic life, irrigation, and power development by heavy sedimentation of streams, reservoirs, and rivers. Reduced energy generation and increased energy costs have caused temporary unemployment in many industries (WEMD 2001).

Drought also reduces ground water resources, but generally not as quickly as it affects surface water supplies. Reduced replenishment of ground water can lead to a reduction in ground water levels and problems such as reduced pumping capacity, wells going dry, or saltwater intrusion in coastal areas such as the Reservation. Shallow wells are more susceptible to drought than deep wells.

Reduced replenishment of ground water also affects streams. Some of the flow in streams comes from ground water, especially in the summer when there is less precipitation and snowmelt slows. Lower ground water levels reduce the amount of water that will enter streams. Low water levels, generally at higher temperatures, have a negative effect on salmonids, which are an important resource for the Lummi people.

In this section, past drought events, drought vulnerability, and potential drought losses on the Reservation are described.

4.7.1 Profiles of Past Drought Events

The National Drought Mitigation Center at the University of Nebraska-Lincoln has compiled drought data for the period 1895 to 1995. Using the Palmer Drought Severity Index, a measure of moisture supply, the center determined the percentage of time during the 100-year period that various regions experienced drought conditions. Their data indicate that the Lummi Reservation suffered severe drought (the fourth of five drought categories) for five to ten percent of the time during this period. For the decade from 1985 to 1995, the Reservation had severe drought conditions from 10 to 20 percent of the time. During the same decade, the majority of the agricultural and hydroelectric area of eastern Washington was in severe or extreme drought for greater than 30 percent of the time (National Drought Mitigation Center 2003).

Specific drought events that affected the state of Washington over the past century are described in Table 4.13. Not all of these regional droughts affected the Reservation directly, but they likely had direct and indirect economic effects on the residents of the Reservation. Greater details for the droughts of 1977 and 2001, the worst and second-worst droughts recorded in Washington State history (since 1895), provide examples of how drought can affect the Reservation region (WEMD 2001).

Table 4.13 Recorded Drought Events in the Lummi Reservation Region¹

Date	Occurrence
November 2000 - October 2001	<ul style="list-style-type: none"> ▪ Precipitation was 56 to 74 percent of normal. Some irrigation water right holders received only 37 percent of their normal water supplies, which allowed other water right holders to get their needed supply. At the end of the irrigation season, 50,000 acre-feet of water was in storage in the five U.S. Bureau of Reclamation reservoirs in eastern Washington, compared with 300,000 acre-feet typically in storage. ▪ More than \$400 million was paid to electricity-intensive industries to shut down and remain closed for the duration of the drought. ▪ Thousands lost their jobs for months, especially aluminum smelter workers. The drought, economic uncertainty, and expensive energy supplies contributed to the job losses. The Alcoa-Intalco Works aluminum plant, just north of the Reservation, shut down from May 18, 2001 to April 30, 2002 due to high electricity costs and is currently operating at a reduced capacity. ▪ More than \$10.1 million in federal disaster aid provided to agricultural growers. ▪ More than \$7.9 million in state funds paid for drought-related projects such as providing irrigation water to farmers with junior water rights and increasing water in fish-bearing streams. ▪ 14 major fires burned more than 178,000 acres; in total, 1,162 fires burned 223,857 acres. Fire-fighting efforts cost Washington State \$38 million and various local, regional, and federal agencies another \$100 million. ▪ A series of drought-related measures were taken at a dozen state hatcheries. ▪ Ecology issued 172 temporary emergency water right permits and changes of existing water rights.
1988	<ul style="list-style-type: none"> ▪ Much of E. Washington in severe drought for over 50% of year.
October 1976 - September 1977	<ul style="list-style-type: none"> ▪ Precipitation at most locations ranged from 50 to 75 percent of normal levels, and in parts of Eastern Washington as low as 42 to 45 percent of normal. ▪ The Washington economy lost an estimated \$410 million over a two-year period. Forecasters estimated the aluminum industry was hardest hit, with major losses in agriculture and service industries, including a \$5 million loss in the ski industry. Layoffs of 13,000 in the aluminum and agriculture industries. ▪ 1,319 forest fires burned 10,800 acres. State fire-fighting activities involved more than 7,000-person hours and cost more than \$1.5 million. ▪ Fish had difficulties passing through Kendall Creek, a tributary to the North Fork Nooksack River. Water levels at trout hatcheries were down. ▪ Ecology issued 517 emergency temporary ground water permits throughout the state to help farmers and communities drill more wells.
Jan.-Aug. 1973	<ul style="list-style-type: none"> ▪ Dry in the Cascades.
June-Aug. 1967	<ul style="list-style-type: none"> ▪ Drought occurred in Washington.
Spring, 1966	<ul style="list-style-type: none"> ▪ The entire state was dry.
1952	<ul style="list-style-type: none"> ▪ Every month was below normal precipitation except June. The hardest hit areas were Puget Sound and the central Cascades.
May-Sept. 1938	<ul style="list-style-type: none"> ▪ Driest growing season in Western Washington.
April 1934- March 1937	<ul style="list-style-type: none"> ▪ The longest recorded drought in the region; the driest periods were April-August 1934, September-December 1935, and July-January 1936-1937.
July-Aug. 1930	<ul style="list-style-type: none"> ▪ Drought affected the entire state. Most weather stations averaged 10 percent or less of normal precipitation.
June 1928- March 1929	<ul style="list-style-type: none"> ▪ Most stations in Washington averaged less than 20 percent of normal rainfall for August and September and less than 60 percent for nine months.
July 1925	<ul style="list-style-type: none"> ▪ Drought occurred in Washington.
July-Aug. 1921	<ul style="list-style-type: none"> ▪ Drought in all agricultural sections of Washington.

Table 4.13 Recorded Drought Events in the Lummi Reservation Region¹

Date	Occurrence
August 1919	▪ Drought and hot weather occurred in Western Washington.
July-Aug. 1902	▪ No measurable rainfall in Western Washington.

¹WEMD 2001; Hart et al. 2001; National Drought Mitigation Center 2003

The 2001 drought began in the fall of 2000. November and December 2000 were unusually dry, and the dry weather pattern continued through January and February of 2001, not returning to normal until March. Since the main source of water for the Pacific Northwest accumulates during the winter, by mid-March much of Washington was suffering from a water supply deficit. Between November 2000 and March 2001, the state received just 60 percent of normal rain and snowfall. With a poor outlook for summer water supplies, there was concern that low river flows would reduce state hydroelectric power production and would put various threatened and endangered fish species at risk. On March 14, 2001, Washington Governor Gary Locke authorized the Department of Ecology to declare a statewide drought emergency. Washington was the first state in the Pacific Northwest to make such a declaration in 2001. After above-average precipitation in the final two months of the year, the drought emergency formally expired on December 31, 2001.

During the 2001 drought, the central part of the state, from the crest of the Cascade Mountains to the east banks of the Okanogan and Columbia rivers, suffered the most from water shortages. Further details of the 2001 drought impacts are (Hart et al. 2001):

- **Energy** – The drought decreased river flows, resulting in less electrical generation and tighter power supplies. Available out-of-state power was extremely expensive, causing higher rates and financial emergencies at many utilities. The Bonneville Power Administration paid electricity-intensive industries to shut down. Many small-scale power generators were placed into emergency service throughout the state.
- **Agriculture** – With stream flows below half of normal and ground water levels threatened, there was significantly less water available for irrigation. About 70 percent of the crops in Washington are produced on irrigated land, which represents about 27 percent of state cropland.
- **Fish** – To help Columbia River fish populations, the Bonneville Power Administration paid growers in the basin to remove 75,000 acres from agricultural production; this kept additional water in the river during the most critical drought months. Improvements were made at a number of hatcheries, and salmon and steelhead were moved out of two hatcheries with water problems.

The main effect of the 2001 drought on the Reservation was probably due to the reduced availability and increased price of power. The primary example of this effect is the extended shutdown of the Alcoa-Intalco Works aluminum plant just north of the Reservation. This plant is a large part of the economy in the Ferndale and Reservation areas; its potential loss means lost wages for residents in the area as well as the loss of multiplied economic activity in the area. Increased power prices obviously affected all other businesses to varying degrees and increased living costs for all residents.

For the 2001 water year (October 2000 to September 2001), Nooksack River annual total runoff and mean streamflow were 67 percent of the average for the 1967 - 2001

period. Mean flow during the months of November, December, and February were less than 50 percent of average for the 35-year period of record, with the February flow being the record low. Flow for November through April, July, and September were all less than 75 percent of average (USGS 2003c). These low flows have adverse effects on fish, including reduced habitat, increased pollutant concentrations, and higher temperatures in July and September. The low summer flows may have impacted agricultural water supplies as well.

4.7.2 Drought Vulnerability Assessment

The entire population on the Reservation is directly or indirectly vulnerable to drought because water availability affects lives in many ways. Residents are directly affected by a reduced water supply, either because well production may cease or be limited, because wells can become contaminated by seawater, because water use restrictions may be implemented, or because water costs may go up. Residents may be indirectly affected if drought effects on hydroelectric power result in increased electricity rates to industry, businesses, and private homes, which has ripple effects throughout the economy. In 2001, higher power rates were one factor resulting in loss of industries and jobs in the region, in particular at the Alcoa-Intalco Works aluminum plant. Another economic factor is a lack of irrigation for agriculture, which results in unemployment and loss of farm production and associated income.

The potential reduction of ground water due to drought is important on the Reservation since over 95 percent of the potable water supply comes from the two aquifer systems found on the Reservation. Since these aquifer systems are near the shoreline, saltwater intrusion is a current problem that could be exacerbated by a severe drought. Overpumping wells during a drought may cause salt water to move into aquifers. The effects on residents can range from the inconvenience of water conservation to severe water shortage.

Approximately 30 percent of the Reservation is currently forested, and many of the homes on the Reservation are interspersed with the forested area. During a drought, these forests have an increased risk of fire, which could be devastating in the loss of homes; recreation, natural, and cultural areas; timber; wildlife; and the possible loss of human life. Because of the proximity of homes to a potential fire, a significant fire-fighting effort would likely be made, which would increase the risk to people.

In addition to the effect on the surface water supply used in the Lummi hatchery program, lower flows in the Nooksack River can have a large impact on salmon production in the river. Salmon are important to the Lummi people both economically and culturally. The lack of harvestable salmon in recent years has had a large social effect on the Reservation because of reduced income, economic uncertainty, and an increase in the high rate of unemployment.

Since the Reservation is a relatively small area, the severity of a drought will be equal in the six assessment areas of the Reservation. However, the direct effects of drought will vary with the availability and demand for water. Residents who rely on low production wells will be more vulnerable than those with more productive wells or those who are connected to the Lummi Water District system. The majority of wells most vulnerable to drought occur on the Lummi Peninsula. With current land uses, the effect on agriculture

will be limited to the floodplain area, the only area where commodity crops are currently grown on the Reservation.

4.7.3 Potential Drought Losses

Although the effects of drought can be large and far-reaching, quantifying these effects is difficult because droughts vary in severity and duration and because many of the effects are indirect, complex, and/or diffuse. Unlike other natural hazards, drought does not represent a hazard to structures (other than the associated increased risk of wildfires). With current land uses, agricultural losses on the Reservation will be largely limited to the Floodplain Area, where approximately 3,000 acres are used to grow corn, beans, potatoes, poplar trees for pulp, and pasture and hay for dairy cows. Low Nooksack River flows will reduce future salmon runs. Eastern Washington droughts that reduce hydroelectric production will have indirect economic effects on the Reservation.

While the 2001 drought affected much of the region, severe droughts that have a large direct effect on the Reservation are relatively rare because of the maritime climate of the region. This climate provides moderate temperatures that minimize the effect of dry periods, and it generally provides rain-producing weather systems often enough to reduce the duration of a drought. Hence, the largest drought losses on the Reservation will generally result from the indirect effects of severe droughts occurring in eastern Washington.

4.8 WILDFIRES

Wildland fires (wildfires), whether naturally occurring or caused by humans, can result in the uncontrolled destruction of forests, brush, field crops, grasslands, and any structures found within the landscape. Fire is a natural part of the ecosystem in the western United States that has been unnaturally reduced in frequency due to fire suppression efforts over the past century. These fire suppression efforts generally resulted in an increase in the volume of wood available to feed a fire. The fire season in the Reservation region typically runs from mid-May through October. Dry periods can extend the fire season. Factors affecting the vulnerability of an area to wildfire include the type and density of vegetative fuel, weather conditions, and topography. Factors affecting potential losses due to wildfire include the number and density of structures, distance of structures from fuels, and proximity to firefighting resources.

Wildfires usually are extinguished while less than one acre in size, but can spread to thousands of acres and may require thousands of firefighters and several weeks to extinguish. Federal, state, county, city, and private agencies and private timber companies typically combine to provide fire protection and firefighting services in the region (WEMD 2001).

Many urban/wildland interface areas are located in some of the most fire-prone fuel areas. The term interface is often used to describe areas where homes and other structures have been built on or adjacent to forest and range lands. While the term is in common use, the situation is not truly an interface. It is not an identifiable line, but rather an intermingling of homes and structures with natural cover or forestlands at various degrees of growth and complexity (Clackamas County 2002). This interface is not limited to remote areas. It occurs wherever development is interspersed with forestlands, a common feature on the Reservation.

In this section, past wildfire events, wildfire vulnerability, and potential wildfire losses on the Reservation are described.

4.8.1 Profiles of Past Wildfire Events

As described previously, based on the accounts of Lummi Elders, early European explorers, and early photographs of the region, before 1850 old growth forests of massive Douglas fir, western hemlock, spruce, and western red cedar dominated what was to become the Lummi Reservation. One or more large fires swept through the Reservation area between 1850 and 1900. These fires destroyed nearly all of the remaining old growth forests. Since reforestation was not practiced during the early logging period, pioneer tree species, such as alder, willows, and cottonwoods, soon replaced the conifer forests and dominated the landscape. Although there are conifer groves and Douglas fir plantations, the present day forests on the Reservation are largely comprised of deciduous trees.

The Pacific Northwest has experienced several disastrous fire seasons over the past century. However, there have been no major fires in forests or grasslands of the Reservation region in recent years. Small fires occur on a nearly annual basis, but are typically extinguished by human intervention before they can expand into a major fire. Examples of such fires include (Whatcom County 2002):

1. A large fire in the wooded Whatcom Creek Park in the city of Bellingham on June 10, 1999, was caused by 277,000 gallons of gasoline pouring into the creek from a ruptured Olympic Pipeline Company gas pipeline. The resulting fire and explosion caused three deaths, burned a house, and did considerable damage to the park and creek ecosystem. However, it did not extend far beyond the creek area that was fueled by the gasoline.
2. In February 1997 a natural gas pipeline (Northwest Natural Gas) explosion and fire in a remote wooded area near Everson also caused a small forest fire.
3. In 1996, a human-caused driftwood fire on Portage Island was extinguished using a bucket brigade (Dunphy 2003).
4. In 1995, a fire on the steep slopes on the southern half of Lummi Island was fought using aerial drops then allowed to burn out.
5. On August 4, 1994, during a drought, a lightening strike on Sumas Mountain ignited a twelve-acre fire in a logged area that had been replanted. The fire spread into nearby standing timber and burned 40,000 to 50,000 board feet of timber. In order to respond, firefighters had to clear debris from logging roads and fill gullies, which slowed the fire response by several hours.
6. A smaller fire in August 1994 was caused by a bonfire on a beachfront along Marine Drive east of the Reservation and spread a mile along the beach and 100 feet high along the bluff east of the Cliffside area at the north end of Bellingham Bay.
7. A one-acre blaze was extinguished August 20, 1993, on state land near Kendall along the North Fork of the Nooksack River.

8. In late August of 1992, nearly 200 federal and county firefighters battled a 40-acre blaze caused by lightning east of Deming, near the confluence of the Nooksack River with its south fork. The cost of this effort was nearly \$500,000.
9. Another fire in August of 1992 burned 13 acres east of Glacier along the North Fork Nooksack River.
10. A one-acre fire caused by lightning burned itself out in late August 1991, four miles northwest of Newhalem in North Cascades National Park.
11. Lightning caused eleven fires on August 12, 1990, in the Mount Baker area near Glacier.
12. In September 1989, sixty firefighters battled an 18-acre forest fire in a clear-cut on state and private timberland near Van Zant. A fire burned a half acre June 1, 1989, on Chuckanut Mountain. In May 1989 a two-day blaze burned seven acres of replanted young trees east of Larrabee State Park.
13. In August 1988, a quarter-acre forest fire on the southwest side of Mount Baker was extinguished by twenty-six federal firefighters.
14. In April 1987, a volunteer fireman suffered minor injuries in a forest fire that burned 1.5 acres south of Larrabee State Park.
15. In August 1985, a 600-acre fire, started by a tree blown onto a power line on Vedder Mountain, six miles east of Sumas, was fought by 350 firefighters from Washington and Oregon. On August 15, 1985, another fire burned five acres east of Interstate 5 in south Bellingham.

The Reservation region has a much lower wildfire frequency than the drier east side of the Cascade Mountains. Figure 4.14 shows the locations and sizes of fires recorded by the Washington Department of Natural Resources in the Reservation area from 1970 to 2001 (WDNR 2003).

4.8.2 Wildfire Vulnerability Assessment

Calculations of fire behavior are based on fuels, topography, and weather, or what is commonly called the fire triangle. According to the fuel model key (excerpted from the National Fire Danger Rating System developed by the U.S. Forest Service) in the Urban Wildland Interface Code (FEMA 2001a), the fire fuels in the forested areas of the Reservation can be described as light to medium (out of three classifications: light, medium, and heavy fuels). In the areas where deciduous trees dominate (the majority of Reservation forests), the fuel classes are light. In the smaller areas of coniferous trees, fuel classes are mostly medium. Because of the low critical fire weather frequency and gentle slopes in the forested areas (less than 40%), the wildfire hazard in these areas is moderate in severity. Heavy fuel, steeper slopes, and/or higher critical fire weather frequency is required for high or extreme fire hazard ratings (FEMA 2001a).

Another tool provided by FEMA estimates the vulnerability of residential areas to wildfire. Using the Wildfire Hazard Rating Form derived from the Urban Wildland Interface Code, the estimated vulnerability to wildfire of forested residential areas on the Reservation is

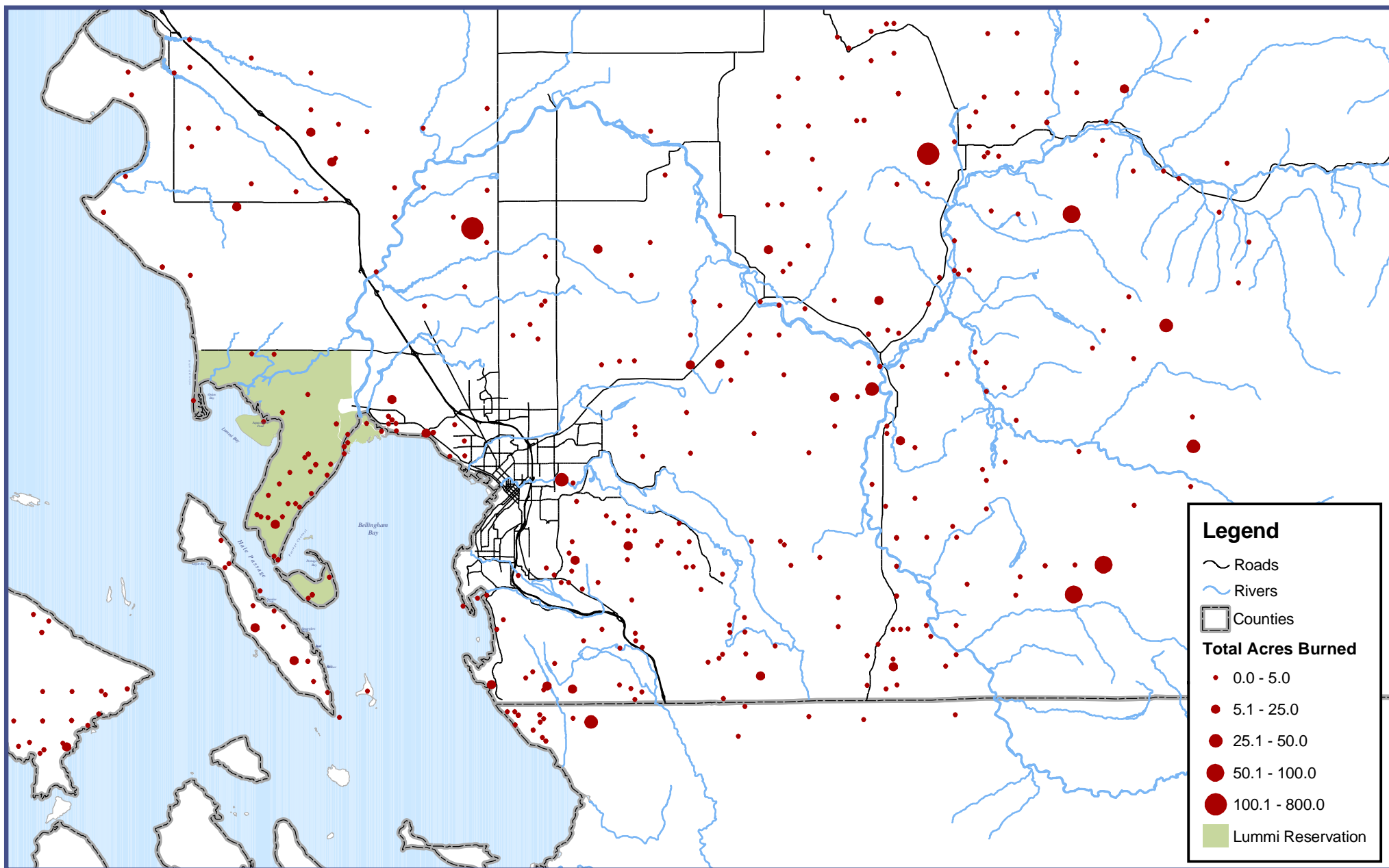
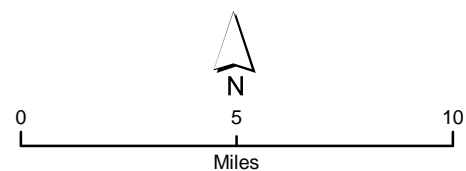


Figure 4.14 Recorded Wildfire Locations and Sizes
in the Reservation Region, 1970-2001 (DNR, 2003)



moderate, largely due to light or medium fuels, slopes of 8% or less, and the relatively close proximity of water sources for suppression (FEMA 2001a).

Much of the uplands above the floodplains on the Reservation are forested and therefore vulnerable to large wildfires. However, the relatively cool, humid, maritime climate, the usually short dry season, the gentle topography, the imposition of burning bans, and the close proximity to firefighting resources combine to make the probability of a damaging wildfire relatively low throughout all six assessment areas on the Reservation. In the rare event that a fire starts, it generally is slow to spread and quick to be contained by firefighters since there are essentially no steep slopes (greater than eight percent slope) to increase the rate of spread and hamper firefighting. A damaging fire on the Reservation would probably require a combination of factors: an extended dry period, hot weather to dry fuels, and winds that are high enough to spread the fire faster than it can be controlled. Although these conditions evidently occurred in the 1800s when there was no fire suppression apparatus in the area, this combination of conditions is currently very rare on the Reservation.

The Lummi Peninsula is the area that is most vulnerable to wildfire on the Reservation. Its moderate vulnerability is based on its extensive forestland, relatively high number of buildings, and the interspersed of buildings with forested areas. The majority of homes on the peninsula are along the shoreline or roads, but many if not most are backed against or into forest, with many surrounded by forest.

The Northwest Upland also consists primarily of forestland and has a moderate vulnerability to wildfire. All of the buildings in this area are homes (except for one unmanned fire station), and all are close to or surrounded by forest. However, there are fewer isolated homes than on the Lummi Peninsula, and the majority of homes are concentrated in two areas, which provides some buffer from the forested surroundings.

Portage Island is largely forestland and has a moderate vulnerability to wildfire. However, because Portage Island is currently uninhabited, structural losses due to wildfire would not occur.

The Sandy Point Peninsula, Gooseberry Point, and Floodplain assessment areas have a low overall vulnerability to wildfire because their limited forestland is generally not in close proximity to buildings. The Sandy Point Peninsula and Floodplain areas have large grasslands that represent a small fire hazard. Figure 4.15 shows the estimated vulnerabilities to wildfire of the assessment areas. These vulnerabilities are in line with those determined by the Washington Department of Natural Resources (Titus 2003; WDNR 2003).

4.8.3 Potential Wildfire Losses

If a wildfire gets out of control, many buildings in its path would face destruction. Table 4.14 lists the number of structures in each developed area of the Reservation that are in close proximity to forestland and the estimated total replacement value of these structures. Such a total loss is unlikely since a fire probably would not burn the whole area and would not completely damage all houses in its path. Thus the estimated potential losses represent a long-term, worst-case scenario.

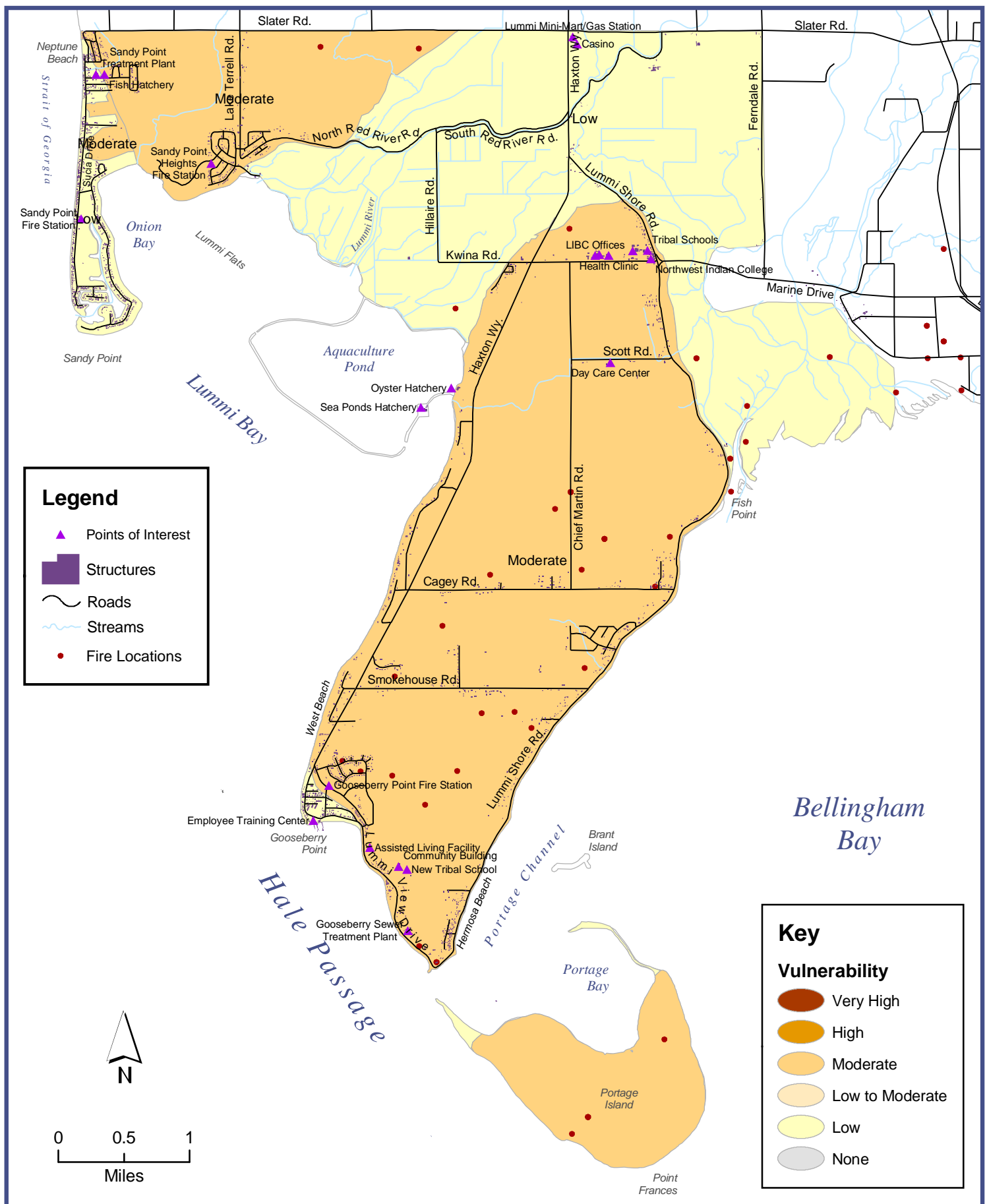


Figure 4.15 Estimated Wildfire Vulnerabilities and Locations of Recorded Wildfires in Reservation Areas

Table 4.14 Vulnerability and Potential Losses of Structures to Wildfires

Assessment Area	Estimated Vulnerability	Number of Structures ¹	Structure Losses ²	Contents Losses ³	Location/Comment
Sandy Point Peninsula	Moderate	10	\$600,000	\$300,000	▪ Forested area adjacent to Northwest Upland
	Low	739	\$0	\$0	▪ Not forested
Northwest Upland	Moderate	285	\$14,706,336	\$7,337,237	▪ Almost entirely forested
Floodplain	Low	70	\$0	\$0	▪ Not forested
Lummi Peninsula	Moderate	1,107	\$89,314,400	\$36,936,000	▪ Majority of structures are in or adjacent to forest
Gooseberry Point	Low	181	\$0	\$0	▪ Not forested
Total		2,392	\$104,620,736	\$44,573,237	▪ Total Wildfire Losses: ~\$149,193,973

¹Residences, outbuildings, and other structures counted from GIS layer of all structures identified on 1998 aerial photos.

²Potential structure losses are the estimated full replacement cost (see Table 4.19 for specific values) of 100 percent of all structures in moderate vulnerability areas.

³Potential contents losses estimated as insured values or half of the structure losses (FEMA 2001a).

A wildfire on the Reservation would result in losses other than those to buildings. Short-term effects of wildfires may include the complete destruction of valuable resources such as timber, wildlife habitat, scenic vistas, and watershed vegetation. Vulnerability to flooding can increase due to the destruction of watershed vegetation. Long-term effects include lost or damaged cultural sites, reduced timber harvests, and less desirable recreational areas. These effects would also have significant economic impacts on Reservation residents.

4.9 LANDSLIDES

A landslide is the movement of rock, soil, and/or debris down a slope that occurs when the materials comprising the slope can no longer resist gravity. Factors that influence landslides (e.g., soil composition and moisture, slope steepness, precipitation, land development and zoning practices, and seismic shaking) generally decrease the shear strength (resistance) of the slope materials and/or increase the shear stress (loading) to the slope. Saturation of slope materials with water, which can be caused by heavy or prolonged rainfall and/or where human activity has altered drainage patterns such that slopes are more likely to become saturated, can decrease slope stability (shear strength). Undercutting of slopes by streams, waves, or construction activity can increase the shear stress and the likelihood of slope failure (landslide). Landslides occur without human influence, but can also be caused or exacerbated by human activities (Oregon 2000b; Ecology 2003a).

Landslides encompass a wide range of slope movements, from small rock falls to debris flows to the failure of entire mountainsides, and multiple landslides types can occur within a single event. The spatial extent of landslides also varies from square feet to square miles. In general, most steep slopes are at some risk of slope failure, and some soil/geologic formations are particularly susceptible to landslide activity, even on relatively gentle slopes. For example, when layers of sand and gravel lie above less permeable silt and clay layers, ground water can accumulate and zones of weakness can develop. In the Puget Sound region, this combination is common and widespread (Ecology 2003a), and it may occur under the slopes of the Reservation.

The following characteristics may be indicative of a landslide hazard area (WEMD 2001):

- Bluff retreat caused by erosion and sloughing of bluff sediments, resulting in a vertical bluff face with little vegetation.
- Pre-existing landslide area.
- Tension or ground cracks along or near the edge of the top of a bluff.
- Structural damage caused by settling and cracking of building foundations and separation of steps from the main structure.
- Toppling, bowed or jack-sawed trees.
- Gullying and surface erosion.
- Mid-slope ground water seepage from a bluff face.
- Topographic convergence (especially as slope increases).

This section describes past landslide events, landslide vulnerability, and potential landslide losses on the Reservation.

4.9.1 Profiles of Past Landslide Events

The primary landslide hazard areas that threaten public safety and structures on the Reservation occur along the marine shoreline where relatively tall and steep bluffs are located. Landslides have threatened and/or damaged private property, residences, and public roads along the shoreline of the Lummi Peninsula. In general, coastal bluffs in Puget Sound are recognized as unstable (WEMD 2001; Ecology 2003a).

Lummi Shore Road and Lummi View Drive are located on the Lummi Peninsula along the marine shoreline of Bellingham Bay and Hale Passage, respectively. In many places, both of these roads are located at or near the top of the bluff along the shoreline. During the 1990s, Lummi Shore Road was reduced to one lane in up to ten places because of the retreat of the shoreline and subsequent undermining and loss of the roadbed. School buses were not allowed to travel portions of Lummi Shore Road. Poor drainage associated with Lummi Shore Road, combined with wave-caused erosion of the base of the bluff, contributed to the rapid retreat of the shoreline and subsequent undermining of Lummi Shore Road. Mitigation of the problem has been a multi-year and multi-million dollar project involving armoring of the shoreline, realignment of the roadway, and much improved storm water drainage along the road (see further details in Section 4.6). The next phase of the project involves creating an inland replacement for a portion of Lummi View Drive and abandoning a portion of the existing Lummi View Drive that is at risk of being lost due to failure of the bluff below the road.

Also along the Lummi Peninsula marine shoreline, bluffs up to 100 feet high occur immediately north of Gooseberry Point along Lummi Bay. Bluffs along this unstable shoreline, labeled on the USGS quadrangle maps as West Beach, have experienced landslides associated with poor residential development practices. In the winter of 2001, during a storm with heavy rains and strong winds from the northwest, at least five landslides occurred in this area. Two of these landslides are shown in Figure 4.16 and are described below.



(a)



(b)

Figure 4.16 Photos of Landslides along West Beach, Lummi Peninsula

In one instance, storm water generated in a development near the shoreline was concentrated and then discharged to property that slopes towards the bluff. The storm water saturated the bluff and the bluff failed (Figure 4.16a). Fortunately, the home at this location is not located adjacent to the bluff. In another instance, landslides occurred that directly threatened a residence (Figure 4.16b). In this case the remaining slope to the beach was nearly vertical and tension cracks continued under the foundation of the home. The house was subsequently moved further away from the bluff. Many other homes in this area are at risk because the bluff is relatively high, composed of materials with weak shear resistance (sand and gravel), and vulnerable to wave erosion at the base of the bluff.

There are also records or evidence of landslides on the coastal bluffs extending north from the Reservation along the Strait of Georgia. The Coastal Zone Atlas of Washington (Volume 1, 1979) shows the locations of these past landslides as well as indicating whether slopes are "stable," "intermediate," or "unstable." It identifies the slope in the Northwest Upland above Neptune Beach as intermediate in stability (Ecology 2003b).

The Reservation is potentially vulnerable to the effects of potential volcanic landslides on Mount Baker. Mount Baker is capable of producing the catastrophic landslides that have occurred recently during the eruption of Mount St. Helens (see details in Section 4.11) and on Mount Adams in south-central Washington. On Mount Adams, massive landslides of large rock debris, snow, and ice occurred between August and October 1997. The slide in October 1997 was approximately 1,500 feet thick and 750 feet wide, with an estimated volume of 106 million cubic feet of rock. The slide was attributed to heavy rain in addition to the exceptionally wet weather in 1995 through 1997 (WEMD 2001). If such volcanic events occurred on Mount Baker, the potential effects on the Nooksack River could extend to the Reservation.

4.9.2 Landslide Vulnerability

The potential for landslides along very limited areas of the Reservation is high, and most of these areas with high vulnerability are located along the Portage Island coastline. The developed areas at high risk are relatively small in geographical extent. High seasonal precipitation, slopes composed of materials with low shear strength (weak layers), wave erosion of the base of slopes along marine shorelines, and the potential for earthquakes all combine to make slopes on the Reservation susceptible to landslide activity, particularly along the marine shoreline. However, the relatively low-relief and gradual topography that occurs over most of the Reservation is not susceptible to landslides. Because the location of weak layers in the sediments below slopes is uncertain or unknown, it is difficult to identify slopes that are more prone to failure. As a result, the estimated landslide vulnerability categories presented in Figure 4.17 are based simply on the following ranges of slope steepness:

- High = 30 percent slope or greater;
- Moderate = 15 to 30 percent slope;
- Low to Moderate = 5.6 to 15 percent slope; and
- None = Zero to 5.6 percent slope.

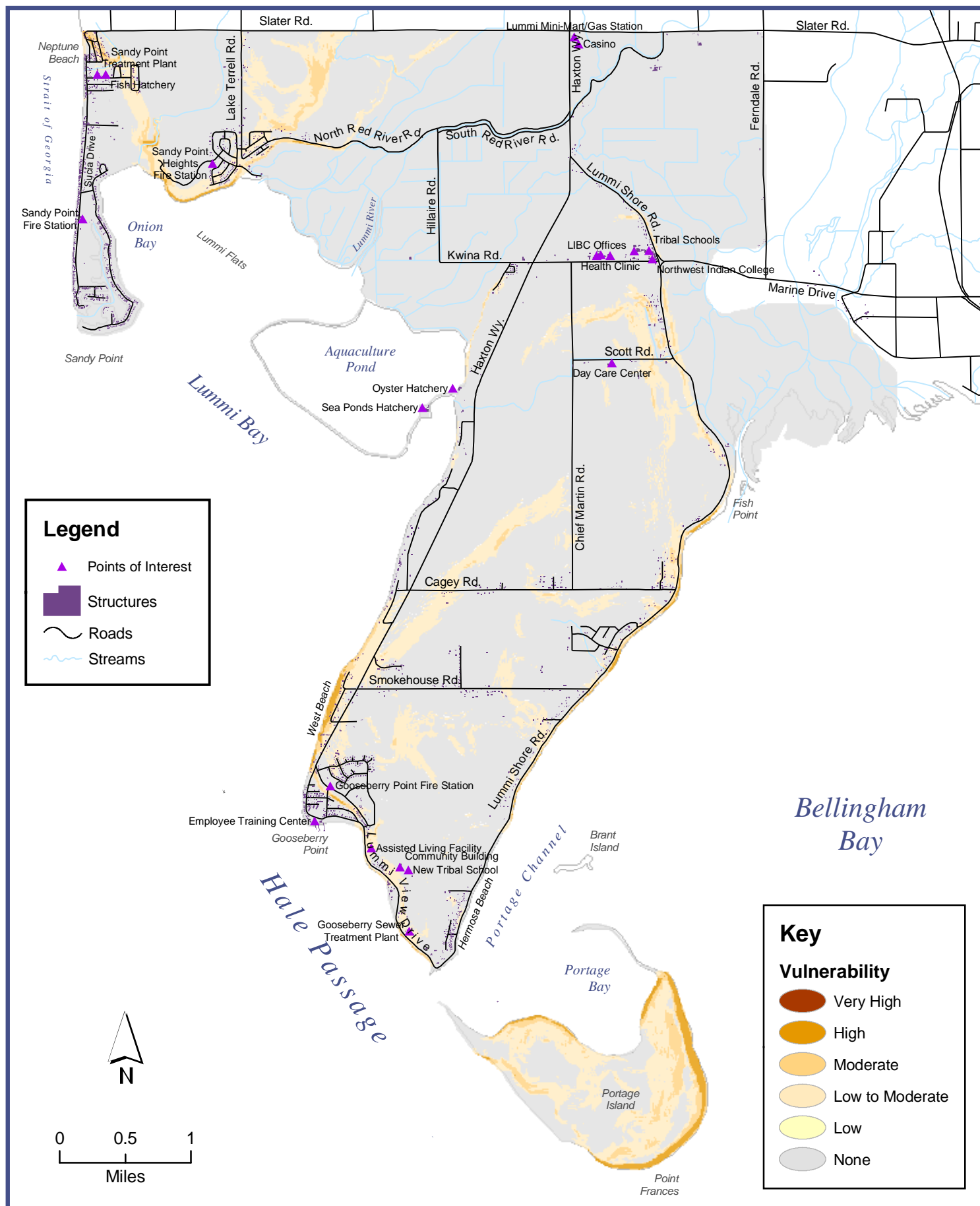


Figure 4.17 Estimated Landslide Vulnerabilities in Reservation Areas

Because people commonly desire a home with a view, many structures have been built above, on, and/or below unstable slopes. A general lack of public awareness about unstable slopes and inconsistent slope mapping and land use regulations contribute to ongoing development in vulnerable areas (WEMD 2001). In addition, where steep slopes occur along shorelines, so-called protection measures employed to address the problem (e.g., bulkheads) can create/exacerbate problems elsewhere along the shoreline. While some protection measures are more effective than others (e.g., good storm water and vegetation management), none are completely effective at eliminating slope instabilities over the long term.

The overall landslide vulnerability of the entire Reservation is difficult to quantify because of the distribution of the hazard: much of the Reservation is at no or minimal risk of slope failure, but some areas are at significant risk of damage due to landslides. In several of the areas prone to landslides, expensive homes have been built at or near the top of bluffs to take advantage of the view of marine waters. Because the developed areas of the Reservation that are susceptible to landslide are relatively small (and not all sloped areas will have weak layers beneath them), the overall relative vulnerability to landslide on the Reservation is low to moderate. However, the probability, or risk, of a damaging landslide in these areas is high, especially if mitigation actions are not employed.

4.9.3 Potential Landslide Losses

Table 4.15 lists the vulnerability levels present in each of the five developed assessment areas (undeveloped Portage Island is not listed), the number of structures that are located in each slope category (vulnerability level) within an area, and the potential losses to landslide. There are no slopes and hence no vulnerability to landslides in the Floodplain assessment area, and limited vulnerability to landslides in the Sandy Point Peninsula and Gooseberry Point areas. Other potentially hazardous slopes on the Reservation, particularly on Portage Island, have not been converted from forested areas. Potential long-term losses were estimated by assuming a worst-case scenario of total loss of all structures located in the moderate and moderate to high vulnerability areas. Using estimated replacement costs for the structures on these properties, the potential total losses on the Reservation would be approximately \$7,213,500.

Bluff retreat is currently occurring along West Beach, just north of Gooseberry Point on the Lummi Peninsula. Fifteen to twenty homes that were built close to the edge of the bluff along this shoreline have significant short- or long-term vulnerability to coastal erosion and resulting landslides. Since many of these homes are located on less than 30 percent slopes and therefore fall into the low-to-moderate and moderate vulnerability categories used in the vulnerability assessment, the estimated vulnerability derived simply from slope categories likely underestimates the long-term, and possibly short-term, vulnerability to landslides along West Beach.

Table 4.15 Vulnerability and Potential Losses of Structures to Landslides

Assessment Area	Estimated Vulnerability	Number of Structures ¹	Structure Losses ²	Contents Losses ³	Location/Comment
Sandy Point Peninsula	Low	9	n/a	n/a	<ul style="list-style-type: none"> Isolated patches of slopes less than ten percent
Northwest Upland	High	10	\$600,000	\$300,000	<ul style="list-style-type: none"> Slopes greater than 30% Most structures on slope above Neptune Beach
	Moderate	39	\$2,340,000	\$1,170,000	<ul style="list-style-type: none"> Slopes of 15% to 30% A few structures in Sandy Point Heights
	Low to Moderate	83	n/a	n/a	<ul style="list-style-type: none"> Slopes of less than 15% Various locations, many of which are likely low vulnerability
Floodplain	None	0	n/a	n/a	<ul style="list-style-type: none"> No slopes
Lummi Peninsula	High	2 ⁴	\$120,000	\$60,000	<ul style="list-style-type: none"> Located along West Beach
	Moderate	28 ⁴	\$1,680,000	\$840,000	<ul style="list-style-type: none"> Most structures along West Beach
	Low to Moderate	234 ⁴	n/a	n/a	<ul style="list-style-type: none"> Various locations, many of which are likely low vulnerability
Gooseberry Point	Moderate	1	\$69,000	\$34,500	<ul style="list-style-type: none"> Home on flat lot along shoreline, partially excavated from slope behind
	Low to Moderate	1	n/a	n/a	<ul style="list-style-type: none"> Base of slope; on shoreline
Total		407	\$4,809,000	\$2,404,500	<ul style="list-style-type: none"> Total Landslide Losses: ~\$7,213,500

¹Residences, outbuildings, and other structures counted from GIS layer of all structures identified on 1998 aerial photos.

²Potential structure losses are estimated full replacement cost (see Table 4.19 for specific values) of 100 percent of all structures in moderate or higher vulnerability areas.

³Potential contents losses are insured values or half of the structure losses (FEMA 2001a).

⁴Since these vulnerability ratings are based simply on percent slope, some of these structures have a higher vulnerability than indicated by slope alone due to their close proximity to the bluff along West Beach.

4.10 TSUNAMIS

A tsunami (pronounced tsoo-nah-mee) is a wave train, or series of waves, generated in a body of water by a sudden disturbance that vertically displaces the water column. The more commonly used term for a tsunami is a “tidal wave”. Earthquakes, landslides, volcanic eruptions, explosions, and even the impact of cosmic bodies, such as meteorites, can generate tsunamis. Tsunamis can travel for thousands of miles at speeds up to 600 miles an hour in deep water before slowing in shallow water as they approach the shore. The waves may hit the shore from 5 to 90 minutes apart, and the first waves are usually not the largest. The size of the waves can also vary greatly along a coastline (Manson 1998; FEMA 2003d). Large tsunamis have caused devastating property damage and loss of life throughout recorded history, particularly around the Pacific Ocean. In 1998, a tsunami generated by a magnitude-7.1 (Richter scale) earthquake centered about 12 miles offshore struck the northern coast of Papua New Guinea. Waves up to 50 feet high reached the shore within 15 minutes of the earthquake, destroying several villages and killing more than 2,200 people. During the

1990s, 82 tsunamis were reported worldwide; the ten that caused deaths claimed more than 4,000 lives (Gonzalez 1999).

Since 1946, six tsunamis have killed more than 350 people and damaged \$500 million of property in Hawaii, Alaska, and the West Coast of the United States. In 1964, the most recent significant tsunami to hit Washington State caused \$105,000 of damage (mostly to bridges) along the Washington coast. This tsunami, generated by the Prince William Sound earthquake in Alaska, was much more destructive in California. The third and fourth waves (11 and 16 feet above tide level) to hit Crescent City killed 11 people and caused \$7.4-16 million (1964 dollars) in damage (Manson 1998; FEMA 2003d).

Although there is no record of a tsunami hitting the Reservation shoreline, the possibility exists. In the following subsections, past tsunami events, tsunami vulnerability, and potential tsunami losses on the Reservation are described.

4.10.1 Profiles of Past Tsunami Events

Evidence of past tsunamis in the Pacific Northwest region has been identified in several locations. On the Washington coast, inland sand deposits are believed to have been carried onshore by the tsunami from the 1700 Cascadia megathrust earthquake. Oral traditions of the native peoples of Vancouver Island indicate that the same tsunami likely destroyed a winter village, with no survivors, at Pachena Bay on the west coast of Vancouver Island (GSC 2002a). In 1946, the magnitude-7.3 Vancouver Island earthquake caused one death due to drowning when a small boat capsized in an earthquake-generated wave. The 1949 magnitude-7.1 earthquake near Olympia probably triggered a landslide three days later at the Tacoma Narrows that produced an 8-foot high tsunami in Puget Sound. Minor wave damage occurred to houses adjacent to the slide, but the opposite shore, hit by the larger wave, was undeveloped at the time (Noson et al. 1988). With increased development along shorelines since that time, a similar event could cause substantial damage today. In addition to the two recorded events above, probable historic tsunami deposits uncovered during recent studies around Puget Sound are among the evidence for an earthquake 1,100 years ago along the Seattle fault (Atwater and Moore 1992).

The most probable and potentially greatest tsunami hazard on the Reservation is posed by a tsunami generated by a Cascadia megathrust earthquake. Recently completed modeling by the Washington Department of Natural Resources indicates that a large tsunami from a Cascadia earthquake would inundate the Sandy Point Peninsula, the Gooseberry Point area, and the Lummi River floodplain up to the Nooksack River, as well as sweeping up the Nooksack River from Bellingham Bay to Ferndale (Walsh 2003). The computer model predicted worst-case water depths of three to six feet in the Sandy Point Peninsula and Gooseberry Point areas and three to sixteen feet in the Floodplain area. A large event could generate flow velocity hazards as the tsunami waves rise and fall, perhaps several times. Since a Cascadia tsunami would be generated by the subduction zone just off the coast of Washington, the warning and response time for the Reservation area would be only two to three hours, possibly just long enough for evacuation of vulnerable areas (Walsh 2003).

Locally generated tsunamis within the Strait of Georgia or San Juan Island region probably represent a smaller and less likely hazard than a Cascadia event, but little is known about their history. For such a tsunami to occur, a "steep and deep" landslide

must occur, that is, a large, steep bluff or hillside must fall rapidly into deep water, or a large, rapid underwater landslide must occur. Potential sources of steep and deep landslides in this region are an intended future subject of research by state and Canadian researchers. Although a locally generated tsunami could cause damage on the Reservation tsunamis of distant origin in the ocean are unlikely to seriously affect inner Puget Sound or the Strait of Georgia and therefore do not represent a significant hazard on the Reservation (Walsh 2003).

4.10.2 Tsunami Vulnerability Assessment

An additional coastal flood hazard is posed by the potential for a tsunami, generated either in the Pacific Ocean (by a Cascadia earthquake) or within Puget Sound or the Strait of Georgia. A detailed but dated study on tsunamis of distant origin concluded that such tsunamis were unlikely to generate a 100-year flood event on the Reservation, both because of the predicted height of potential tsunamis and because the simultaneous occurrence of high tide and a storm surge or high, wind-generated waves with a tsunami was determined to be highly unlikely (Garcia and Houston 1975). However, geologists have greatly increased their knowledge of earthquake and tsunami events since the mid-1970s. Many new, major faults have been identified since 1975, including faults in the North Puget Sound and Strait of Georgia area. In general, the estimated risk of a significant tsunami in the area has risen in recent years (Johannessen 2000b). The 2003 Revised Preliminary Flood Insurance Study for the Reservation area does not provide any new analysis of this possibility. Given the large degree of uncertainty regarding tsunami sources and the limited data on locally generated tsunamis, determining the probability of a tsunami on the Reservation is difficult.

Considering that only two locally generated tsunamis have been recorded over the last century in the Puget Sound/Strait of Georgia area, and that not all tsunamis are large enough to cause damage, it appears that a damaging tsunami event on the Reservation has a low probability. However, the Sandy Point Peninsula, Floodplain, and Gooseberry Point areas are particularly vulnerable to a tsunami from the subduction zone and tsunamis generated locally in the Strait of Georgia, which represents a fairly large source for a local tsunami. Although perhaps unlikely, or at least very low frequency (Cascadia subduction events have a return period of 400-600 years), a large tsunami event on the Reservation could have severe consequences in these heavily developed, low-lying coastal areas. Figure 4.18 shows the estimated relative tsunami vulnerabilities in the six assessment areas.

4.10.3 Potential Tsunami Losses

The potential losses from a tsunami on the Reservation are greater than those described previously for coastal flooding because the depths and velocities of flooding are potentially greater over a much larger area. Depending on the severity of the event, damages may range from inundation of a handful of homes to destruction of many buildings. A large event could result in total loss of most buildings on the Sandy Point Peninsula, heavy damage to other buildings on the Sandy Point Peninsula, total loss or heavy damage at Gooseberry Point, and damage to the aquaculture dike in Lummi Bay, the Lummi Bay seawall, and properties in the Floodplain area. Damage could also occur along Hermosa Beach and the remainder of the Lummi Peninsula shoreline.



Figure 4.18 Estimated Tsunami Vulnerabilities in Reservation Areas

Table 4.16 lists the number of structures vulnerable to tsunami in the five developed assessment areas and the estimated potential losses that would result from a worst-case scenario, defined as total destruction of all structures in areas judged to have moderate or higher vulnerability.

Table 4.16 Vulnerability and Potential Losses of Structures to a Tsunami

Assessment Area	Estimated Vulnerability	Number of Structures ¹	Structure Losses ²	Contents Losses ³	Location/Comment
Sandy Point Peninsula	Very High	255	\$13,704,000	\$6,852,000	▪ Western shoreline is very highly vulnerable
	High	494	\$21,799,000	\$10,899,000	▪ South Cape and interior homes highly vulnerable ▪ Sea level rise would increase hazard
Northwest Upland	Low	0	\$0	\$0	▪ Road detours are potential inconvenience
Floodplain	High	67	\$12,764,000	\$8,262,000	▪ Several homes raised after 1990 floods ▪ Potential damage to Casino and Mini-Mart limited by flood damage reduction measures
	Moderate	7	\$809,500	\$140,800	▪ Seaponds Hatchery buildings on aquaculture dike; dike itself has high vulnerability to storm waves and failure of the Lummi Bay seawall
Lummi Peninsula	Moderate	202	\$8,699,000	\$4,350,000	▪ Hermosa Beach, Stommish, West Shore areas
	Low to Moderate	901	\$0	\$0	▪ Isolation due to closed roads ▪ Economic impacts on employers and employees
Gooseberry Point	Very High	43	\$8,763,160	\$1,589,530	▪ 20 homes along western shore, plus outbuildings ▪ LIBC mini-mart, office building, and piers
	High	138	\$2,972,830	\$1,472,466	▪ Interior homes, outbuildings, and warehouses
Total		2,107	\$69,511,490	\$33,565,796	▪ Total Tsunami Losses: ~\$103,077,000

¹Residences, outbuildings, and other structures counted from GIS layer of all structures identified on 1998 aerial photos.

²Potential structure losses estimated as 100 percent of 2003 assessed improvements (if area is primarily fee land), estimated residential replacement value (if area is mixed fee and trust land), and/or insured values (see Table 4.19 for specific values).

³Potential contents losses estimated as 100 percent of insured values or 50 percent of the structure losses (FEMA 2001a).

4.11 VOLCANO

A volcano is a vent in the crust of the earth through which magma (molten rock), rock fragments, gases, and ash are ejected from the interior of the earth. A volcanic mountain is created over thousands of years by the accumulation of these erupted materials on the surface of the earth. Mount Baker is a 10,781-foot high volcano that lies approximately 37 miles due east of the Reservation. The volcanic hazards presented by Mount Baker include:

- Lava flows: Lava is molten rock that pours onto the Earth surface during an eruption. Numerous eruptions of lava interbedded with rock rubble constructed Mt. Baker.
- Pyroclastic flows: Hot avalanches of lava fragments and volcanic gas formed by the collapse of lava flows or eruption clouds.
- Tephra: Fragments of rock that are blasted high into the air by explosive eruptions. Large fragments fall close to the volcano. Small fragments (called ash) from the largest eruptions can travel hundreds or thousands of miles.
- Lahars: Fast-moving slurries of rock, mud, and water that look and behave like flowing wet concrete. Landslides can transform into lahars. Pyroclastic flows can generate lahars by melting snow and ice.

Evaluation of volcanic hazards is primarily that of predicting lahar, pyroclastic flow, and related flash flood paths based on topography, and ash fall patterns based on prevailing wind patterns. Prediction of eruptions has only recently become a possibility where seismographs placed on volcanoes may detect the subsurface movement of magma. Lahars are the greatest concern at Mount Baker because of its history of frequent lahars and the ability of lahars to flow for tens of miles. Lahars generated by volcanic landslides can be triggered by eruptions, regional earthquakes, gravity, or increases in hydrovolcanic activity (i.e., steam generation) that is not associated with magma intrusion. When ground water comes into contact with either magma or hot rock, hydrovolcanic explosions of steam and rock can occur. Such events, in addition to possibly triggering collapse, can themselves be hazardous (Gardner et al. 1995; Scott et al. 2000).

In this section, past volcanic events, volcanic vulnerability, and potential volcanic losses on the Reservation are described.

4.11.1 Profiles of Past Volcanic Events

Mount Baker is an active volcano, and one of the youngest in the Cascade Range. Volcanic activity in the Mount Baker area began more than a million years ago, and many of the earliest deposits have been removed by glacial erosion. Its most recent significant activity was in 1843, at a time when permanent populations around its base were few and extensive development of structures had not yet occurred. Table 4.17 describes the past volcanic events at Mount Baker (Gardner et al. 1995; Scott et al. 2000; WEMD 2001).

Table 4.17 Past Volcanic Events at Mount Baker¹

Specific Year or Years Ago	Description of Event
1975 - Present	Increased steam and gas emission from Sherman Crater. Heat flow increased more than tenfold, then gradually declined over two years before stabilizing at a higher level than before 1975.
1958	Boulder Glacier mudflow and avalanches.
1891	About 20 million cubic yards of rock fell from flank, producing a lahar that flowed more than six miles and covered one square mile.
1843	Large hydrovolcanic eruption and flank collapse in Sherman Crater. Widespread tephra and forest fires. Ash-clogged rivers killed many salmon. Lahar raised natural Baker Lake at least ten feet.
100 - 300	Boulder Creek mudflow and tephra. Rainbow Creek avalanche.
300 - 6,000	Tephra. Middle Fork Nooksack River and Park Creek mudflow.
6,000 - 10,350	Pyroclastic and lahar flows and tephra. Tephra eruption produced ash layer 20 miles to the northeast. Middle Fork Nooksack River mudflow, probably to Bellingham Bay. Boulder Creek lava flows. Sulphur Creek mudflow and lava flow. Park Creek mudflow.
10,350 - 15,000	Multiple lava, pyroclastic, and lahar flows and tephra eruptions from summit. Sulfur Creek and other mudflows.

¹ Gardner et al. 1995; Scott et al. 2000; WEMD 2001.

The last event that directly affected the area of the Reservation to a significant level was about 6,600 years ago, when the largest flank collapse in the post-glacial history of the volcano occurred. A lahar was produced that was over 300 feet deep in the upper reaches of the Middle Fork Nooksack River. This lahar was at least 25 feet deep 30 miles downstream from the volcano and probably reached Bellingham Bay. The initial flank collapse was followed by a huge hydrovolcanic explosion that triggered a second collapse and lahar that traveled at least 20 miles. An eruption cloud deposited several inches of ash as far as 20 miles downwind (Scott et al. 2000).

Mount Baker is presumably capable of producing an event that would rival the 1980 Mount St. Helens eruption that killed 57 people and caused huge, widespread damage. The collapse of Mount St. Helens produced a landslide (the largest in recorded history on Earth) that buried 14 miles of the North Fork Toutle River valley to an average depth of 150 feet. The initial blast cloud accelerated to at least 300 mph and traveled as far as 17 miles northward. Later, hot pyroclastic flows traveled at 50 to 80 mph as far as 5 miles northward. Several lahars poured into river valleys, ripping trees from the banks and destroying roads and bridges along the way. The lahars damaged or destroyed a total of 27 bridges and nearly 200 homes. The largest and most destructive lahar eroded material from both the huge landslide deposit and the channel of the North Fork Toutle River. It increased in size as it traveled downstream, and after 15 hours reached its maximum size in the Cowlitz River about 50 miles downstream from the volcano. Sediment deposition reduced the carrying capacity at flood stage of the Cowlitz River at Castle Rock from 76,000 cfs to less than 15,000 cfs; the channel depth in the Columbia River was reduced from 40 to 14 feet, stranding 31 ships in upstream ports (Brantley and Myers 2000). Since the Nooksack River flows through the Reservation, a comparable eruption event at Mount Baker would have a substantial impact on the Lummi Nation.

The Mount St. Helens eruption also deposited 1.4 billion cubic yards of (uncompacted) ash. The downwind depth of ash was ten inches at ten miles (ash and pumice), one inch at 60 miles, and 1/2 inch at 300 miles (Brantley and Myers 2000).

4.11.2 Volcano Vulnerability Assessment

Scientists define a volcano as active if it has erupted in historic time or is seismically or geothermally active. By this definition, Mount Rainier, Mount Baker, and Mount St. Helens are active volcanoes in Washington State. Volcanoes commonly repeat their past behavior. It is likely that the types, frequencies, and magnitudes of past activity will be repeated in the future. Hence, it is likely that at some point another lahar will flow down the Nooksack River, causing damage on the Reservation from flooding and sedimentation (Gardner et al. 1995).

The potential effects of a large lahar on the Reservation will be similar to that of a large Nooksack River flood (see Section 4.2.2.1 for details). The Floodplain area is vulnerable to inundation, sedimentation, and damage to structures. Ground transportation to the Lummi Peninsula could be cut off, leaving the peninsula isolated until the roads are cleared. The Sandy Point Peninsula and Northwest Upland areas would face the inconvenience of detour routes.

The level of sedimentation from a lahar would be much greater than that from a flood. Such sedimentation would reduce the capacity of the river; heavily impact salmon populations; alter the delta, Bellingham Bay, and shellfish beds in Portage Bay; and potentially change the course of the Nooksack River, even redirecting it into the Fraser River in Canada via the Sumas River drainage. The latter event would have dramatic effects on the entire region. Figure 4.19 shows regional volcanic hazards that may result from an eruption of Mount Baker.

Areas downwind of a volcanic eruption are also vulnerable to reduced visibility, ash fall, and caustic gases. Ash falls are harsh, acidic, gritty, smelly, and cause lung damage, particularly to the young, old, or people suffering from respiratory problems. When atmospheric sulfur dioxide combines with water it forms diluted sulfuric acid that causes burns to skin, eyes, mucous membranes, nose, and throat. Acid rains affect water supplies, strip and burn foliage, strip paint, corrode machinery, and dissolve fabric. Heavy ash falls blot out light. Heavy demand for electric light and air conditioning can cause a drain on power supplies. Ash clogs waterways and machinery, causes electrical short circuits, and drifts into roadways, railways, and runways. Very fine ash is harmful to mechanical and electronic equipment. The weight of ash causes structural collapse, particularly when it becomes saturated with water. Because it is carried by winds, it continues as a hazard to machinery and transportation systems for months after the eruption (WEMD 2001). Although the prevailing winds on the Reservation are westerly, occasional weather patterns blow from the east and would expose the Reservation to ash fall (Gardner et al. 1995). A potential ash fall could equally affect all six assessment areas of the Reservation.

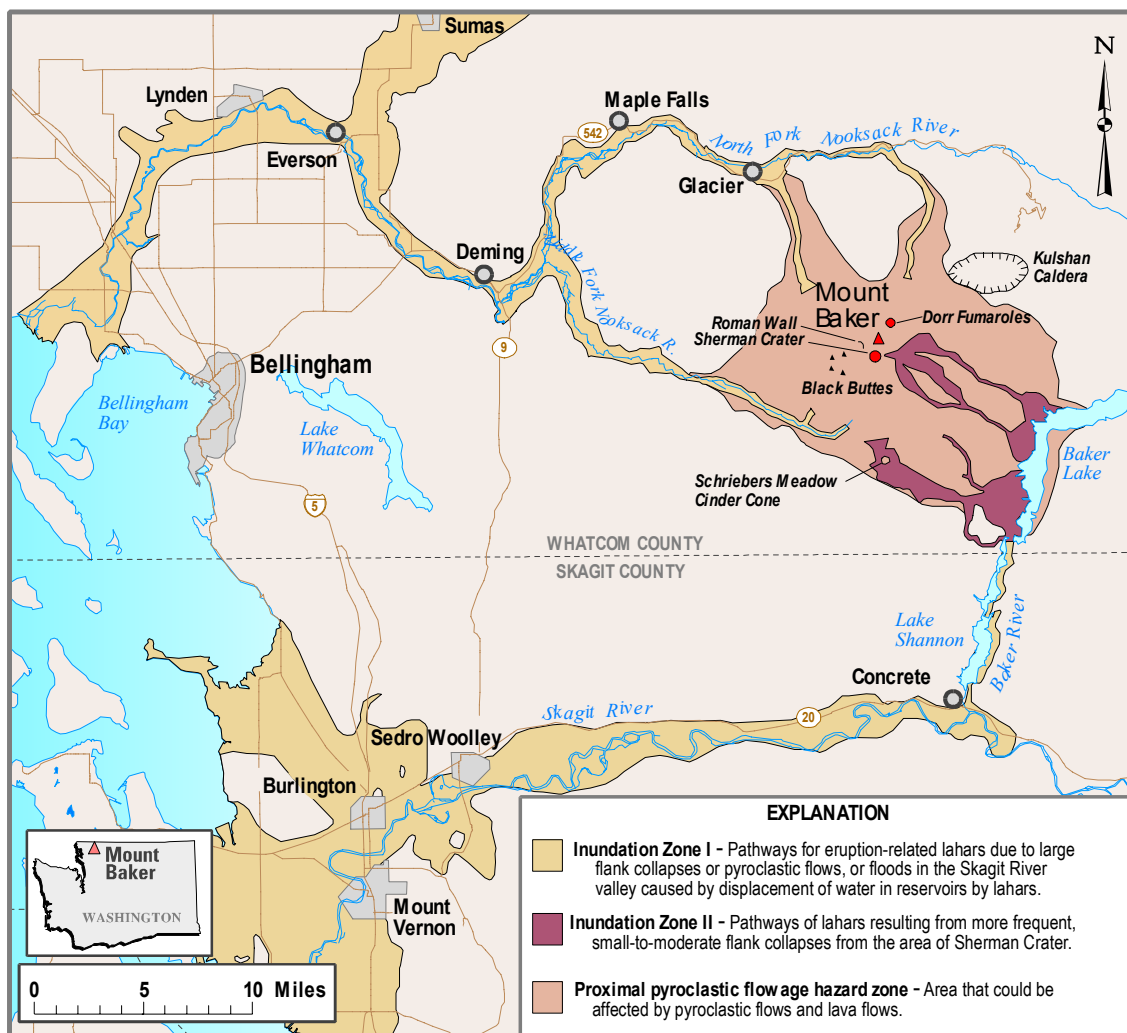
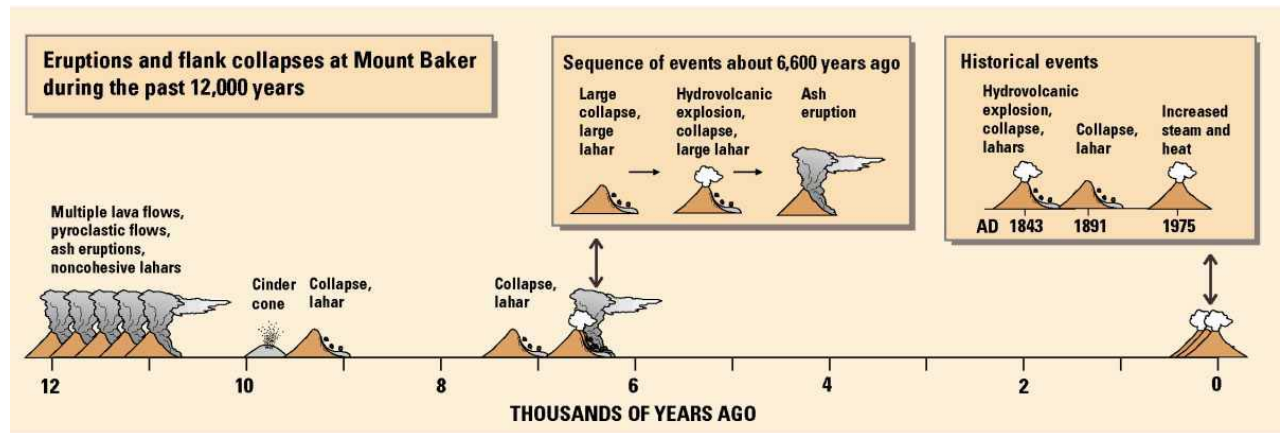


Figure 4.19 Mount Baker Eruption History and Regional Volcanic Hazards

Volcanoes usually exhibit warning signs that can be detected by instruments or observations before erupting. However, explosions caused by heated material encountering ground water can happen without warning. Since Mount Baker is monitored closely by the Cascades Volcano Observatory, it is likely that the public will be warned before a potential eruption occurs. Such a warning would allow the preparation and implementation of measures that may reduce the impacts of an eruption (Gardner et al. 1995).

Overall, the vulnerability of the Reservation to a Mount Baker eruption ranges from low to high, depending on the area. However, the probability of a large, damaging eruption is very low since these types of eruptions only occur thousands of years apart. Figure 4.20 shows the estimated relative volcano vulnerabilities in the six assessment areas of the Reservation. Areas affected only by road detours and/or ash (i.e., Sandy Point Peninsula, Northwest Upland, and Portage Island) were assessed a low volcano vulnerability. Areas affected by isolation because of road closures (i.e., Lummi Peninsula and Gooseberry Point) and by ash were assessed a moderate volcano vulnerability. The vulnerabilities and probabilities for the six areas and for specific structures on the Reservation are listed in Table 4.18.

4.11.3 Potential Volcano Losses

The potential losses to structures on the Reservation are essentially the same as for a Nooksack River flood. As with a large flood, residents and businesses in the assessment areas would be affected economically by the closure of offices and businesses, fewer customer visits, effects on the regional economy, and the cost of recovering from the disaster. Section 4.2.3.1 describes the details of potential losses from a Nooksack River flood on the Reservation.

An ash fall on the Reservation would result in some damage to the painted surfaces of buildings and vehicles and potential damage to mechanical and electrical systems. The effects of ash would present a threat to public health and safety and residents and/or the government would incur the costs of care and treatment.

Sedimentation in the Nooksack River and Portage Bay from a lahar could cause large losses for tribal harvesters of salmon and shellfish. The impacts on salmon populations in the Nooksack River could be long-term if spawning and rearing habitats are buried under large volumes of sediment. Impacts on shellfish populations in Portage Bay are less likely than salmon impacts in the Nooksack River, but potentially could be long-term.

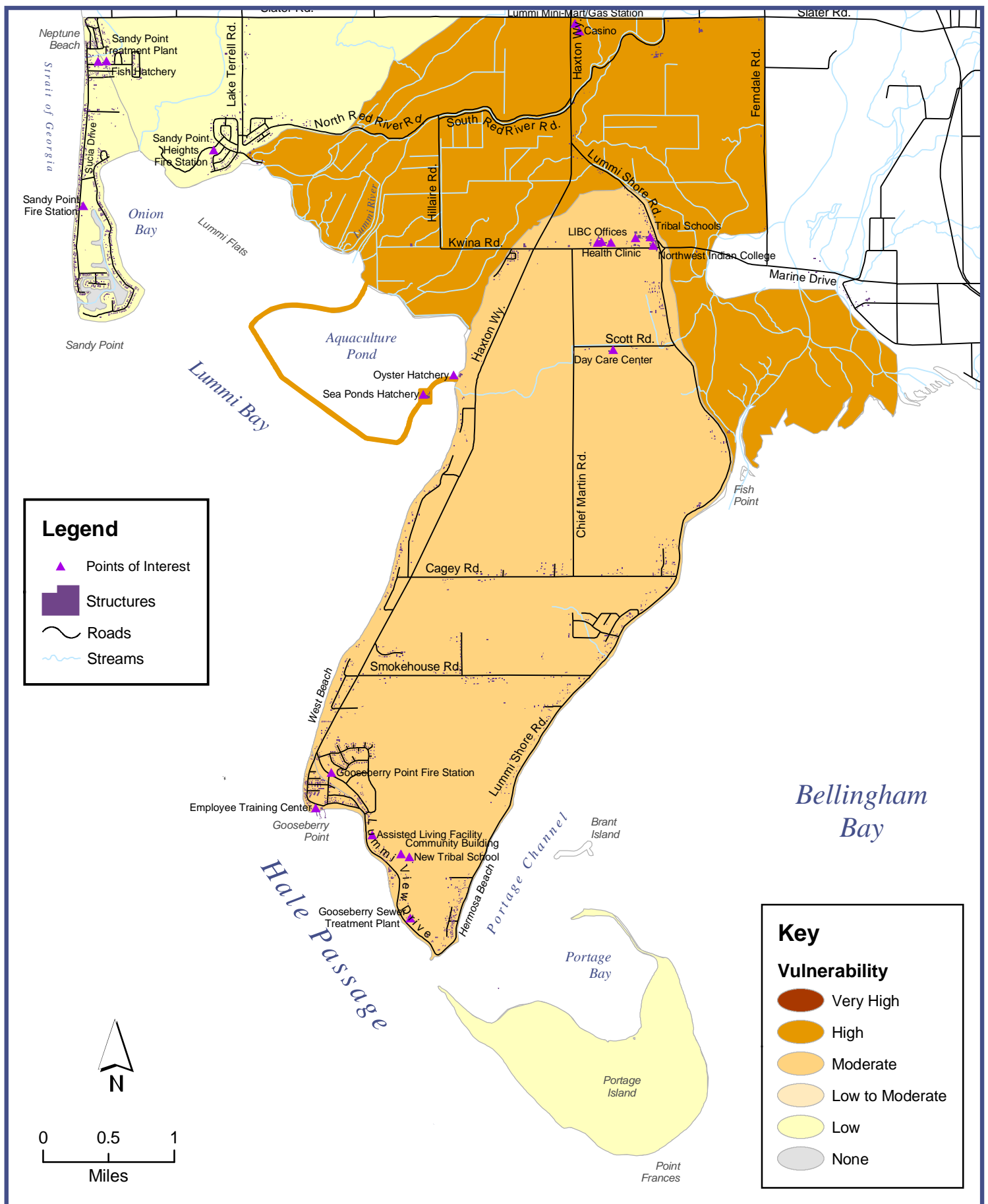


Figure 4.20 Estimated Volcano Vulnerabilities in Reservation Areas

4.12 RISK ASSESSMENT SUMMARY

Table 4.18 lists the six assessment areas and primary facilities on the Reservation, the hazards that potentially threaten them, the estimated relative vulnerability to the hazard, and the estimated relative probability or frequency of damage from a hazard event occurring. The estimated vulnerability represents an overall rating for the hazard sites within a Reservation area. In these ratings, consideration was given to the vulnerability of an area relative to other areas, both on and off the Reservation. Many of the hazards pose a threat to an entire area; these threats may vary across an area (e.g., wildfire), may be largely uniform across an area (e.g., earthquake, winter storm, or drought), or may vary in some areas and be uniform in other areas (e.g., flood). Other hazards pose site-specific threats (e.g., landslides and coastal erosion) and the vulnerability rating for an area is based on the hazard sites in the area and not the whole area. That is, although there is a generally low to moderate vulnerability in the landslide-prone areas of the Lummi Peninsula, there is also a high vulnerability in a few specific locations, while the remainder of the peninsula is not vulnerable to landslide.

Figure 4.21 depicts the combined, estimated, multi-hazard vulnerability of the six assessment areas on the Reservation for all of the assessed hazards except drought and coastal erosion. (Drought vulnerability was considered equal for the whole Reservation and was not mapped for this MHMP; relative coastal erosion vulnerabilities were not mapped on the uplands and therefore did not overlap with the mapping of the other hazards.) The combined vulnerability for the eight natural hazards mapped on the upland areas was determined using GIS by assigning values of zero to five to the vulnerability levels of none, low, low to moderate, moderate, high, and very high, respectively. These values were summed for each point on the map and overall vulnerability levels were then assigned to appropriate ranges of summed values. The overall vulnerability levels reflect the relative vulnerability between areas on the Reservation. Table 4.19 lists the number and value of critical and other public facilities, commercial facilities owned by the Lummi Nation, and residences in the six assessment areas of the Reservation.

Table 4.18 Summary of Hazard Vulnerability and Probability on the Reservation¹

Assessment Areas and Critical Facilities within each area	Flood	Earthquake	Winter Storm	Windstorm	Coastal Erosion	Drought	Wildfire	Landslide	Tsunami	Volcano
Sandy Point Peninsula Assessment Area	H	H	M	M/H	M/H	M	L	L	H	L
	H	M	H	H	H	L/M	L	L	L	L
Sandy Point Fire Station	M	M	M	M/H	L	M	L	—	H	L
	H	M	H	H	M	L/M	L	—	L	L
Lummi Sewer District Treatment Plant	L	M/H	M	M	L	M	L	—	H	L
	H	M	H	H	M	L/M	L	—	L	L
Northwest Upland Assessment Area	L ²	M	M/H	H	M	M	M	L/M	L ²	L ²
	H	M	H	H	M	L/M	L/M	M/H	L	L
Sandy Point Heights Fire Station	L ²	L	M	M/H	L	M	M	L/M	L ²	L ²
	H	M	H	H	M	L/M	L/M	M/H	L	L
Floodplain Assessment Area	H	H	H	M	L	M	L	—	H	H
	H	M	H	H	H	L/M	L	—	L	L
Silver Reef Casino, Shell Mini-Mart and Gas Station	M	L/M	M	M	L	L/M	L	—	H	M
	H	M	H	H	H	L	L	—	L	L
Lummi Peninsula Assessment Area	L/M ²	M	M/H	H	M/H	M	M	L/M	L/M ²	M ²
	H	M	H	H	H	L/M	L/M	M/H	L	L
Gooseberry Point Fire Station	L/M ²	L	M	M	—	M	M	L	L/M ²	M ²
	H	M	H	H	—	L/M	L/M	L	L	L
Lummi Sewer District Treatment Plant	L/M ²	M	M	M/H	L	M	M	L/M	L/M ²	M ²
	H	M	H	H	H	L/M	L/M	M/H	L	L
Elders Assisted Living Facility	L/M ²	L	M	M	—	M	M	L	L/M ²	M ²
	H	M	H	H	—	L/M	L/M	L	L	L
New Tribal School and Wex li em Comm. Bldg.	L/M ²	L	M	M	—	M	M	—	L/M ²	M ²
	H	M	H	H	—	L/M	L/M	—	L	L
Health Clinic, Police Station, Headstart, LIBC Offices, K-12 School, NWIC, Archives	L/M ²	L/M	H	M	—	L/M	M	—	L/M ²	M ²
	H	M	H	H	—	L	L	—	L	L
Gooseberry Point Assessment Area	M/H ²	H	M	M/H	M	M	L	L	H ²	M ²
	H	M	H	H	M	L/M	L	L	L	L
Portage Island Assessment Area	L/M	M/H	M/H	H	M/H	M	M	M/H	L	L
	H	M	H	H	H	L/M	L/M	M/H	L	L

¹Vulnerability to hazard is ranked on top; probability or frequency of damaging event is ranked below; H = High, M = Moderate, L = Low, / = Intermediate.

²Northwest Uplands is affected but not isolated by flood road closures; facilities on the Lummi Peninsula are isolated and therefore merit a higher vulnerability to flood, lahar, and tsunami.

³— = not applicable

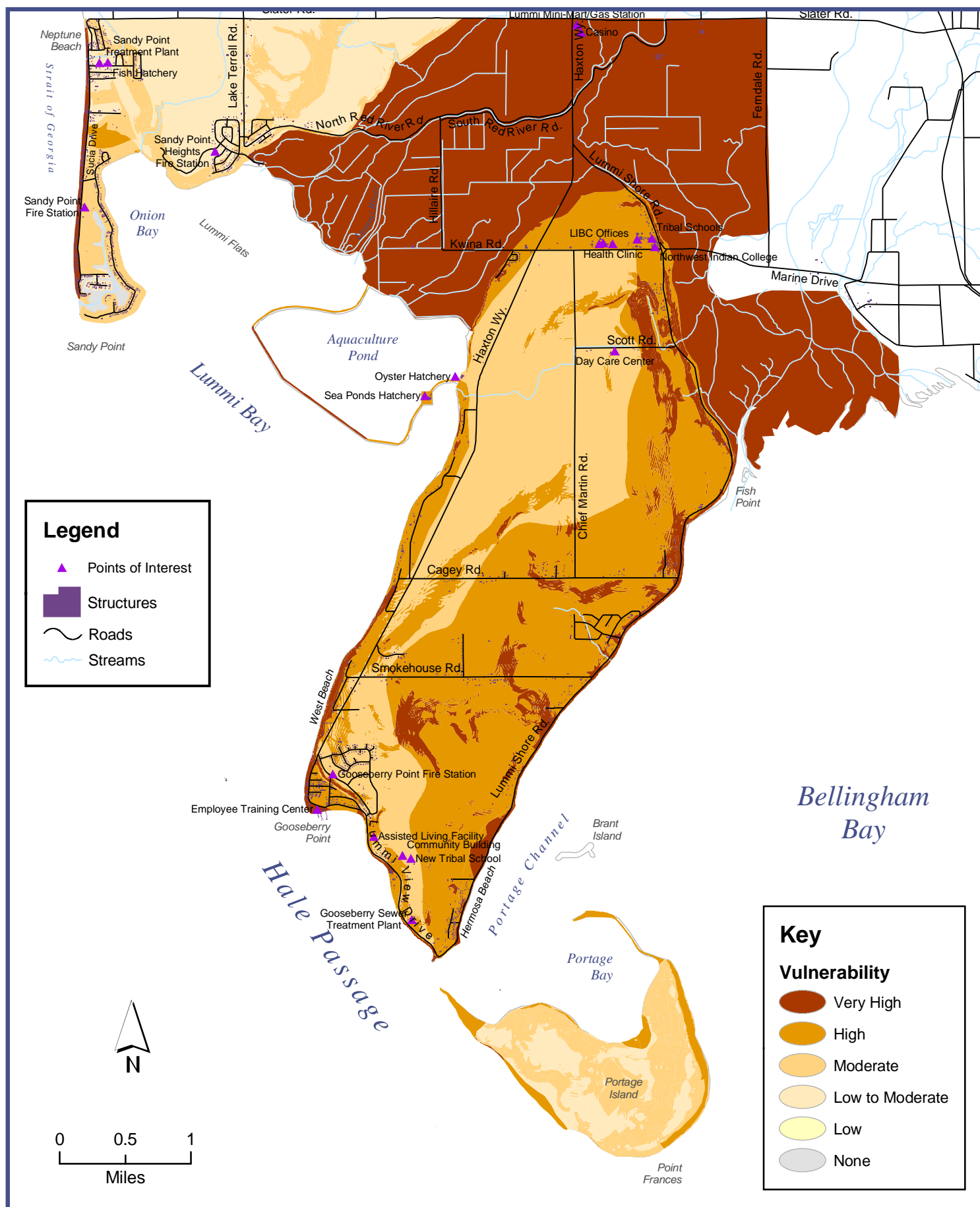


Figure 4.21 Combined Relative Multi-Hazard Vulnerability on the Reservation

Table 4.19 Number and Value of Structures in the Six Assessment Areas

Area	Structure Type	Number of Structures ¹	Estimated Value ²		Comment
			Structure(s)	Contents ³	
Sandy Point Peninsula	Lummi Water and Sewer District Facilities	5	\$157,000	\$500,000	▪ Critical: Public Health and Safety
	Sandy Point Fire Station	2	\$303,560	\$294,000	▪ Critical: Public Safety ▪ Contents include \$200,000 for pumper truck, estimated \$80,000 for aid car
	LIBC Hatchery	2	\$202,400	\$67,100	▪ Enhances tribal salmon harvest
	Residences, Outbuildings, and Other Structures	~740	\$35,503,000	\$17,751,500	▪ 2003 assessed value of improvements for all fee parcels ▪ Values for small number of trust properties not available
	Area Total	~749	\$36,165,960	\$18,612,600	
Northwest Upland	Sandy Point Heights Fire Station	1	\$32,136	\$225,237	▪ Critical: Public Safety ▪ Contents include \$223,000 for two pumper trucks
	Lummi Natural Resources Pump House, Water Tank	2	\$200,200	\$0	▪ Critical: Water Supply
	Lummi Water District Lake Terrell Booster Station	1	\$50,000	\$0	▪ Critical: Water Supply
	SPIC Water District Pump House, Tank	2	\$200,000	\$0	▪ Critical: Water Supply
	Residences, Outbuildings, and Other Structures	~279	\$14,224,000	\$7,112,000	▪ 2003 assessed value of improvements for all fee parcels ▪ Small number of trust property improvements not available
	Area Total	~285	\$14,706,336	\$7,337,237	
Floodplain	LIBC Silver Reef Casino	1	\$7,975,000 ⁴	\$6,100,000 ⁴	▪ Important income source and job provider; ▪ Average daily wages = \$15,314 ⁴
	LIBC Shell Mini-Mart	1	\$1,129,000 ⁴	\$332,000 ⁴	▪ Income source; Average daily wages = \$1,013 ⁴
	Seaponds Hatchery	7	\$809,500	\$140,800	▪ Enhances tribal salmon harvest
	Residences, Outbuildings, and Other Structures	~65	\$3,660,000	\$1,830,000	▪ Estimated replacement value = 61 x 1,000 sq. ft. x \$60/sq.ft. ▪ Estimated values include structures on both fee and trust land (2003 fee land assessed improvements = \$835,478)
	Area Total	~74	\$13,573,500	\$8,402,800	
Lummi Peninsula	Gooseberry Point Fire Station	1	\$203,000	\$317,000	▪ Critical: Public Safety ▪ Contents include 1989 engine and an aid car
	LIBC Law & Order Police Station	1	\$190,000	\$44,000	▪ Critical: Public Safety
	LIBC Tribal Health Clinic	1	\$2,568,500	\$1,755,600	▪ Critical: Public Health
	Lummi Water & Sewer District Facilities	25	\$1,003,000	\$479,000	▪ Critical: Water Supply and Quality, Public Health ▪ Well buildings, pump stations, and sewage treatment facility
	LIBC Wex li em Community Bldg	1	\$2,532,200	\$190,000	▪ Critical: Red Cross Shelter with emergency provisions

Table 4.19 Number and Value of Structures in the Six Assessment Areas

Area	Structure Type	Number of Structures ¹	Estimated Value ²		Comment
			Structure(s)	Contents ³	
Lummi Peninsula	LIBC Little Bear Creek Elders Home	1	\$3,500,000	\$0	▪ Vulnerable population (seniors assisted living facility)
	Lummi Head Start	2	\$795,300	\$101,200	▪ Vulnerable population (~90 preschool children)
	Lummi Tribal School	18	\$3,901,700	\$756,500	▪ Vulnerable population (~260 K-12 children)
	Northwest Indian College	16	\$3,932,000	\$1,275,400	▪ Approximately 580 full- and part-time students
	LIBC Archives Building	1	\$400,000	\$108,000	▪ Important historical and cultural artifacts and documents
	LIBC Courthouse	1	\$300,000	\$150,000	▪ Includes offices for tribal justice system and legal staff
	LIBC Oyster Hatchery	4	\$2,161,500	\$367,400	▪ Income source (\$500,000 annual sales) and job provider
	LIBC Water Tower & Pump	2	\$514,300	\$0	▪ Critical: Water Supply
	LIBC Offices & Other Buildings	16	\$6,276,400	\$1,211,900	▪ Various services to tribal members and Reservation residents ▪ Daily LIBC payroll is approximately \$58,000
	Stommish Ground	7	\$676,500	\$0	▪ Recreation area
	Residences, Outbuildings, and Other Structures	~1,011	\$60,660,000	\$30,330,000	▪ Estimated replacement value = 1,011 x 1,000 sq.ft x \$60/sq.ft ▪ Estimated values include structures on both fee and trust land (2003 fee land assessed improvements = \$22,737,000)
	Area Total	~1,107	\$89,314,400	\$36,936,000	
Gooseberry Point	LIBC Commodity Food Warehouse	1	\$273,900	\$123,000	▪ Supplemental food storage
	LIBC Employment Training Center	1	\$1,800,700	\$435,600	▪ Important social services
	LCC Fisherman's Cove Pier	1	\$2,041,000 ⁴	\$0 ⁴	▪ Boat storage, launching, and pier that support tribal fishery
	LIBC Fish Buying Station	1	\$2,547,600	\$44,000	
	LCC Fisherman's Cove Mini-Mart	1	\$400,000 ⁴	\$123,000 ⁴	▪ LIBC income source; Average daily wages = \$685 ³
	Whatcom County Ferry Terminal	1	\$3,336,400	\$0	▪ Provides access to Lummi Island community ▪ Transportation off Lummi Peninsula during flood road closures
	Residences, Outbuildings, and Other Structures	~176	\$10,560,000	\$5,280,000	▪ Estimated replacement value = 176 x 1,000 sq.ft x \$60/sq.ft ▪ Estimated values include structures on both fee and trust land (2003 fee land assessed improvements = \$4,673,000)
	Area Total	~181	\$17,623,200	\$6,005,600	
Portage Island	None	n/a	n/a	n/a	• Currently undeveloped and unoccupied

¹Residences and other structures counted from GIS layer of all structures identified on 1998 aerial photos. Total structures does not include utility lines.

²Unless otherwise noted (e.g., residences, Lummi Commercial Company), estimated values are insured values of structures and contents (Brown & Brown 2003; Crawford 2003; Peterson 2003; Schlehuber 2004).

³For residences and other structures, the estimated contents value equals half of the structure value.

⁴Insured values reported by Lummi Commercial Company (Mace 2003).

5. MITIGATION STRATEGY

5.1 HAZARD MITIGATION GOALS AND OBJECTIVES

The following goals and objectives were adapted from the Lummi Nation Flood Damage Reduction Plan (FDRP; LWRD 2001a), adopted by the Lummi Indian Business Council in November 2001 and approved by FEMA in January 2002.

Goals

The goals of the Lummi Nation MHMP are to:

1. Reduce the threats to public health and safety posed by natural hazards;
2. Reduce the structural damages caused by natural hazards;
3. Reduce the environmental impacts of natural hazards, mitigation actions, and future development activities; and
4. Reduce the long-term costs resulting from natural hazards and their mitigation.

Objectives

The objectives of the MHMP are the following:

1. Prevent new development in areas that are vulnerable to hazards or ensure that development occurs in such a way that risk is minimized;
2. Protect or alter existing development in hazardous areas to make it less susceptible to damage;
3. Ensure that the solution chosen to protect existing development is the most cost-effective available; protects or enhances cultural resources, natural resources, and sensitive terrestrial, riparian, or coastal habitats; and is consistent with applicable land use plans and regulations;
4. Ensure that the benefits of maintaining existing facilities outweigh their costs; if not, redesign facilities to make them less susceptible to damage or implement some other type of solution at the site;
5. Redesign existing projects and/or change maintenance practices to protect or enhance riparian or coastal habitats;
6. Manage floodplains, rivers, streams, and other water resources for multiple uses, including flood- and erosion-hazard reduction, fish and wildlife habitat, finfish and shellfish harvesting, open space, recreation, water supply, cultural/traditional practices, and hydropower;
7. Improve coordination and consistency between the Lummi Nation and other jurisdictions, as appropriate, in management activities for floodplain and coastal areas;

8. Increase public awareness of natural hazards and improve appropriate preparation for and response to such hazards; and
9. Improve hazard warning and emergency response systems.

5.2 TRIBAL AND LOCAL CAPABILITY ASSESSMENT

This section will discuss the pre- and post-disaster hazard management policies, programs, and mitigation capabilities of the Lummi Nation and the other jurisdictions that provide support services to the Lummi Nation during disasters on the Lummi Reservation. This discussion will include an evaluation of Lummi Nation laws, regulations, policies, and programs that are related to hazard mitigation and to development activity in hazard-prone areas. Funding capabilities for hazard mitigation projects are also discussed. The local capability assessment includes a general description and analysis of the mitigation policies, programs, and capabilities of local organizations on the Reservation (e.g., Lummi Water and Sewer District, Northwest Indian College, and the tribal schools).

5.2.1 Tribal Capability Assessment

Land Use Plans and Development Regulations

Land use planning is a necessary and useful tool for addressing natural hazards. With land use planning and associated regulations, a jurisdiction is able to reduce future damages by controlling the density, location, construction, and type of development that occurs in a hazardous area. The Lummi Nation Planning Department, Natural Resources Department, and Cultural Resources Department administer regulations that control development in environmentally sensitive and hazardous areas on the Reservation. Whatcom County has historically exerted permitting authority for fee lands (i.e., lands where property taxes are assessed and paid to the county) on the Reservation and permitted nearly all of the development that is currently located in the most hazardous areas on the Reservation.

As described in Section 3.1.3, the Lummi Nation is striving to reduce potential hazards by regulating where and how development occurs. The policies and regulations include the Lummi Nation Building Code; Land Use, Development, and Zoning Code; Coastal Zone Management Plan; and the Water Resources Protection Code. The current Building Code adopts the Uniform Building Code by reference, which includes seismic design standards (the Reservation is in Seismic Zone 3) and wind design standards (the Wind Speed Area is 80 mph, with exposure factor B or C). These standards have been in place since the Uniform Building Code was adopted by the Lummi Nation in 1975. The Lummi Building Code was amended in January 2004, primarily to update references to various uniform codes. The Lummi Nation plans to adopt the International Building Code when it is adopted by other jurisdictions in the near future.

As noted previously, there are approximately 38 miles of marine shorelines on the Reservation. The Lummi Coastal Zone Management Plan (CZMP) provides important guidance on development in the coastal zone, which is the location of the most serious hazard vulnerabilities on the Reservation. The CZMP was adopted in 1979 and is scheduled to be updated by 2007 to improve its ability to reduce hazard damages as

well as other environmental impacts associated with development activities along the shoreline.

The LIBC incorporated the environmental review and permitting provisions of a Tribal Environmental Policy Act (TEPA; LWRD 2003) into the recently adopted Title 15 Land Use, Development, and Zoning Code. These provisions formalize an environmental review process that has been functioning since it began in 1968 with the adoption of an interim zoning ordinance by the LIBC. The original Zoning Ordinance and other LIBC ordinances (e.g., the Tidelands Ordinance, Water Code, and Coastal Zone Management Plan) initiated procedures for project review and permitting. Approval for projects came from the designated Lummi Planning Department staff, unless the project appeared to be controversial. More controversial projects required approval by the Lummi Planning Commission.

To improve the permitting system, the Lummi Nation Technical Review Committee (TRC) was created in October 1996. The purpose of the TRC was to refine the LIBC environmental review capacity so that the Lummi Nation's goals related to resource protection and compliance with federal and tribal laws could be supported, while the development needs of Reservation landowners could also be met. In 1997, the LIBC charged the TRC with reviewing proposed land use activities on the Reservation and implementing tribal and federal laws to protect public and private resources. The TRC is composed of representatives from each of the seven departments of the LIBC.

In early 1997, the TRC incorporated provisions of the National Environmental Policy Act (NEPA) into two revised permit applications, one for small projects and one for large projects. These applications are generally compatible with the environmental review checklist required off-Reservation under the Washington State Environmental Policy Act (SEPA). Completed permit applications are distributed to all department representatives. The representatives assemble comments for consideration at the weekly TRC meeting. At the TRC meeting, an application is either not approved pending further information, approved, approved with conditions, or denied.

The permit applications also help the TRC members determine if additional review is required pursuant to the NEPA or other federal laws. The TRC incorporated the basic aspects of the NEPA process into its review process, including an environmental checklist; the concept of avoiding, minimizing, and mitigating impacts; and the use of Environmental Assessments (EAs) or Environmental Impact Statements (EISs) to consider the effects of major projects. If it appears that a project will have a significant impact on natural or public resources and there is a federal nexus (e.g., federal permitting or federal funding), an EA or an EIS is required to comply with the NEPA. Upon completion, the EA or EIS is evaluated by the TRC to determine project approval, conditioned approval, or denial (LWRD 1999). This environmental review process allows the TRC to ensure that the method and type of development that occurs in hazard areas minimizes the potential for future damages. The new Lummi zoning code adopted in January 2004 codifies the TRC and the NEPA provisions described above that previously had been authorized by an LIBC resolution (Resolution No. 97-104).

In 1968, the federal government began the National Flood Insurance Program (NFIP) as a way to limit future development in flood-prone areas and thereby prevent additional flood damages. The NFIP, which is administered by FEMA, qualifies residents of communities that adopt and administer minimum floodplain regulations for federally

subsidized flood insurance. The Lummi Nation adopted floodplain regulations in 1997 in the form of the Title 15A Flood Damage Prevention Code (FDPC; see Appendix D). Following the adoption of the FDPC, the Lummi Nation joined NFIP on October 14, 1997. The NFIP Community Number for the Lummi Reservation is 530331. The Reservation moved from the emergency phase to the regular phase of the NFIP with the release of final Flood Insurance Rate Maps (FIRMs) and a Flood Insurance Study for the Reservation on January 16, 2004. The availability of flood insurance and regulation of development within the floodplain will help reduce overall damage and costs on the Reservation after future floods. In addition, by joining the NFIP, the Lummi Nation is eligible to apply for state and federal grant programs to reduce flood hazards and repair flood damages.

Further details on the FDPC can be found in Section 5.3 and in the Lummi Nation Flood Damage Reduction Plan (FDRP; LWRD 2001a).

Flood Damage Reduction Plan Policies

An extensive list of policies recommended to guide floodplain, coastal, and watershed management activities are described in the Lummi Nation FDRP (LWRD 2001a), adopted by the LIBC in 2001 (Resolution No. 2001-131). These policies provide a set of operating principles to guide flood mitigation efforts over the long term. The policies are divided into seven categories: general policies; floodplain land use; watershed management; flood mitigation projects; river channel maintenance; flood warning, information, and education; and emergency response. These policies will help the Lummi Nation meet its goals and objectives for hazard mitigation. A summary of the policies is attached in Appendix E.

Wildfire Policies and Programs

The Lummi Nation Title 10 Natural Resources Code (first enacted March 6, 1964; last amended September 24, 2001) designated the Lummi Natural Resources Department (LNR) to be responsible for forest management on the Reservation. Chapter 10.18 (Forestry) of the Natural Resources Code established a forest practices review process, permit terms and conditions for forestry activities, and fire suppression authority for the LNR. The forestry chapter gave the LNR the authority to issue regulations governing burning on the Reservation during hazardous periods, including but not limited to:

- An open burning ban;
- The requirement for an open burning permit with conditions for fire protection; and
- Providing requirements for safe burning.

The Lummi Nation adopted a Forest Management Plan in August 2002 (LNR 2002) to support a comprehensive program to manage the forest resources on the Reservation. The program will require or encourage management practices that will reduce the probability of wildfires on the Reservation.

All Hazards

The Lummi Nation has developed an Emergency Management Response Interim Plan (Appendix C) and is in the process of developing a Spill Prevention and Response Plan so that it will have guidelines in place to direct LIBC actions in the event of a disaster or

hazardous material spill. In addition, the LIBC Safety Officer will potentially develop a Comprehensive Emergency Management Plan that will coordinate with other plans and establish procedures for LIBC departments to follow in case of an emergency. These plans will instruct responsible officials and employees how to respond in order to minimize the effects of such a disaster.

The Lummi Nation currently responds to all disasters with its limited resources and by enlisting the assistance of local construction contractors to provide services. The LIBC policy is to coordinate with and support the Whatcom County Division of Emergency Management both on and off the Reservation. Gary James (Chief of Police, Lummi Law and Order) and Andy Kamkoff (Construction Manager, Lummi Planning Department) currently are members of the Whatcom County Emergency Response Team. During local disasters, one of them may join the team at the Whatcom County Emergency Operations Center and generally remain at the center until the disaster is resolved. Curt Russell, the LIBC Safety Officer, is now the LIBC representative to the Washington State Homeland Security (HLS) Region 1 Council and the primary LIBC contact person with the Whatcom County Division of Emergency Management. This participation by the Lummi Nation provides an important communication role by providing the county with the Lummi Nation perspective on possible responses to a disaster and helps ensure an effective response (Kamkoff 2003).

Because property tax revenue from fee lands on the Reservation is currently paid to Whatcom County, the LIBC has limited revenue and generally has higher funding priorities than hazard mitigation. Outside funding is therefore necessary to implement mitigation projects that have significant costs. The Lummi Nation is eligible for and has received Hazard Mitigation Grant Program funds when a disaster has been declared in Washington State. Other sources indirectly related to hazard mitigation, such as Economic Development Authority grants or Environmental Protection Agency grants, may help fund projects that have implications for hazard mitigation. In addition, the LIBC may be able to implement some inexpensive mitigation actions, such as public education, with current staffing. For example, the LIBC has a communication office that publishes a community newspaper (the Squol Quol) and provides community information through a cable news program. These and other media (e.g., newsletters, flyers, and telephone calls) have been used in the past and are currently used to provide public education or information to the community.

5.2.2 Local Capability Assessment

The LIBC is the only government on the Lummi Reservation and has sole jurisdiction for hazard mitigation and other programs on the Reservation. Thus, for the purposes of this “state-level” PDM mitigation plan, there are no local governments under the LIBC to be assessed. The local public organizations on the Reservation (e.g., Lummi Water and Sewer District, Northwest Indian College, and the tribal schools) are under the oversight of the LIBC and have limited scope and limited capabilities to respond to a disaster. They are basically responsible for their own facilities and commonly need assistance to recover from a disaster. It is the intention of the Lummi Nation to provide leadership, guidance, and assistance to private citizens, businesses, and other Reservation organizations, both through the tribal capabilities described above and through the mitigation measures described below in Section 5.3.

5.3 MITIGATION MEASURES

This section will identify, evaluate, and prioritize feasible and environmentally sound mitigation actions currently in use or under consideration by the Lummi Nation. This discussion will include an explanation of how each activity contributes to the overall mitigation strategy for the Lummi Nation. Where pertinent, links to local organizations will be identified.

For the purposes of this MHMP, short-term actions are those actions that the Lummi Nation is capable of implementing within its existing resources and authorities over the next two years. Long-term actions are those actions that will require new or additional resources or authorities to implement, and those actions that cannot occur or be completed over the next two-year period.

5.3.1 All Hazards

5.3.1.1 Current Mitigation Actions

As described in Section 5.2, current mitigation actions employed by the Lummi Nation that apply to all hazards include land use plans and development regulations, emergency management and spill response plans that are under development, and coordination with the Whatcom County Emergency Response Team. For early warning of impending hazard events, the LIBC relies on communication with the Whatcom County Division of Emergency Management as well as pertinent federal and state agencies. Residents on the Reservation receive warnings from public news outlets as well as through the LIBC.

5.3.1.2 Proposed Mitigation Actions

The following actions are recommended to meet the Lummi Nation's goals and objectives for mitigation of all hazards:

Short Term:

1. Establish the formal goal of becoming a disaster-resistant Indian nation, including objectives or benchmarks for preparedness;
2. Establish and maintain a Multi-Hazard Mitigation Team comprised of representatives from pertinent LIBC departments and other organizations on the Reservation;
3. Approve a Comprehensive Plan that is aligned with the provisions of the Title 15A Flood Damage Prevention Code, the FDRP, other hazard-related ordinances and regulations, and the recommendations of this MHMP;
4. To help disseminate the MHMP, expand knowledge of hazard mitigation on the Reservation, and encourage further mitigation actions, this plan should be posted on the Lummi Nation web site, and links to further hazard mitigation information (e.g., DisasterHelp.gov) should be posted as time and resources permit;
5. Adopt, implement, and maintain the Lummi Nation Emergency Management Response Plan (Appendix C);

6. Develop, implement, and maintain the Lummi Nation Spill Prevention and Response Plan;
7. Coordinate LIBC emergency response efforts, as appropriate, with those of Whatcom County and other federal, state, and local agencies;
8. Establish 24-hour emergency medical response capability (an equipped Medic 1 unit along with paramedics and emergency medical technicians) located on the Reservation; and
9. Promote the establishment and maintenance of home survival/emergency kits.

Long Term:

1. Pursue funding for the Lummi Nation mitigation priorities and recommendations described below, including funding for needed staff and infrastructure;
2. Promote a disaster and hazard mitigation fund to assist the mitigation and response efforts of individuals and organizations on the Reservation;
3. Coordinate hazard planning, as appropriate, with other jurisdictions; and
4. Improve and sustain public information and education programs aimed at mitigating natural hazards.

A Hazard Mitigation Team can play a major role in hazard mitigation activities, including the monitoring and development of this MHMP. Establishing a permanent team is important because it would be the only Lummi Nation organization focused on coordination of multi-hazard mitigation. The LIBC resolution (Appendix A) that adopted this MHMP authorizes the formation of a Multi-Hazard Mitigation Team and directs the LIBC General Manager or his designee to coordinate the formation, staffing, and operations of this team and to ensure its effectiveness. The coordinator for this team is expected to be the LIBC Safety Officer.

Establishing benchmarks for preparedness will help maintain focus on the goal of developing a disaster-resistant Indian nation. These benchmarks will track progress towards institutionalizing preparedness and hazard mitigation, including the characterization of natural hazards; the presence of ordinances or standards to mitigate natural hazards; and ongoing education on natural hazard preparedness and mitigation. By measuring or tracking progress toward achieving the benchmarks and being accountable to the LIBC, the chances of success will increase.

Creation of a disaster and hazard mitigation fund would allow financial commitments to be made quickly to support hazard mitigation. However, with the current lack of property tax revenue and other competing needs of Reservation residents, the availability of funding to meet immediate emergency needs, including early hazard mitigation activities, and support disaster preparedness efforts is a major concern. Federal assistance programs require various matching fund contributions from applicants and are not guaranteed to exist in the future. Hence, creation of a hazard fund is necessarily a long-term action; the importance of this action will depend on the availability of future outside funding.

Many post-disaster reports note the need to strengthen and sustain public information, education, and training efforts by providing additional resources (Oregon 2000a). Although it is commonly recognized that interest in reducing losses increases during and after events, there is an ongoing need to provide residents with hazard mitigation information. Post-disaster assessment reports cite the need to have timely seasonal information available, have better methods to inform residents where they can obtain hazard mitigation information, use improved electronic methods (e.g., web sites), and have materials oriented toward the intended users. This helps keep awareness levels higher, will stimulate actions by some, and reminds users to consider and include hazard mitigation measures in the contexts of regular activities, such as building a new home, relocating an office, or repairing a business.

5.3.2 Floods

5.3.2.1 Current Mitigation Actions

To date, various governmental agencies in the Nooksack River basin have used five different approaches to reduce the costs and impacts of flooding:

- Flood control structures;
- Channel maintenance;
- Flood warnings;
- Land use plans; and
- Development regulations.

Flood control structures, channel maintenance, and flood warnings are used to protect existing properties in flood hazard areas. Land use plans and development regulations are used to prevent future development that would be vulnerable to flooding and reduce the impacts of new construction on flooding. A more complete description of past and current flood mitigation activities is contained in the Lummi Nation FDRP (LWRD 2001a).

Flood Control, Elevation, and Floodproofing

The primary flood control measures protecting the riverine floodplain on the Reservation are the 5- to 10-year levees along the bank of the Nooksack River and the sea wall along Lummi Bay. In addition, Marine Drive was raised after the 1990 floods to reduce the frequency of closures during low magnitude floods. However, Marine Drive is still inundated by less than one-year floods. Many of the existing homes in the floodplain along Haxton Way were raised to the base flood elevation after the 1990 floods (LIBC 1997). Some homes west of Lummi Shore Road were also flood-proofed after the 1990 floods (Deardorff 1996). The Whatcom County CFHMP for the lower Nooksack River describes other past and current mitigation activities that have occurred upstream from the Reservation (Whatcom County 1997a, 1999).

Past coastal flood mitigation along exposed Reservation shorelines has largely consisted of construction of bulkheads, which have become bigger and higher over the years, especially along the southern Sandy Point shoreline. These bulkheads extend below the high tide level and onto tribal tidelands (an on-going legal issue between the United States and the Lummi Nation and Sandy Point homeowners that is currently the subject of a federal lawsuit: *United States, Lummi Nation vs. Keith E. Milner and Shirley*

A. Milner, et al., Civil Action No. C01-809R [U.S. District Court, Western District of Washington]). These bulkheads have resulted in substantial physical and biological damages to tribal tidelands. Physical damages that result from bulkheads include increased beach scour/erosion, a steeper beach and therefore decreased tideland area, increased net shore drift rate, a coarser beach, sediment impoundment along the up-drift side and landward of bulkheads, increased erosion along the down-drift extent of bulkheads (“end effects”), and loss of storm berm and beach resiliency. Biological damages caused by bulkheads include loss of habitat area, decreased and degraded shellfish habitat, likely loss of spawning habitat for surf smelt and sand lance, increased predation of juvenile salmon, less stable beach, loss of organic debris on beach, and unknown “threshold effects”.

Rip-rap shore armoring was also used along most of the length of Lummi Shore Road to reduce coastal flood impacts and prevent erosion that undermined the road and created a public health and safety hazard. The recognized negative physical and biological effects of this project are being mitigated through a beach nourishment program.

Land Use Plans and Development Regulations

The Lummi Planning Department administers regulations that control development in flood hazard areas on the Reservation. As described in Section 3.1.3, the Lummi Nation is striving to reduce potential hazards by regulating where and how development occurs.

To reduce flood vulnerability, the Lummi Nation adopted floodplain regulations in 1997 in the form of the Title 15A Flood Damage Prevention Code (FDPC; see Appendix D). Following the adoption of the FDPC, the Lummi Nation joined the NFIP on October 14, 1997. The Reservation moved from the emergency phase to the regular phase of the NFIP with the release by FEMA of final Flood Insurance Rate Maps (FIRMs) and a Flood Insurance Study for the Reservation and the surrounding area on January 16, 2004. The lack of FIRMs for the Reservation was the only requirement that kept the Lummi Nation in the emergency phase of the NFIP. The previous FIRMs for the Nooksack River and coastal shorelines were revised and released by FEMA in 1990, but they contained no data for the Lummi Reservation. Updated Preliminary FIRMs, which include the Lummi Reservation, were released in 1999, 2002, and 2003; the LWRD reviewed and provided comments on all of these revised Preliminary FIRMs. The final FIRMs include a recent study of the Sandy Point Peninsula coastal flood hazard, but do not include a floodway south of Ferndale. Further hydraulic modeling is required in order to define a floodway in this area. The availability of flood insurance and regulation of development within the floodplain will help reduce the overall damage and costs on the Reservation after future floods. In addition, by joining NFIP, the Lummi Nation is eligible to apply for state and federal grant programs to reduce flood hazards and repair flood damages.

The NFIP program establishes a 100-year floodplain that is divided into two zones: a floodway and a flood fringe. Development may be permitted in these areas if it satisfies conditions and requirements regarding the height of the first floor of a structure above the projected 100-year flood elevation, flood-proofing construction, displacement of floodwaters, and related concerns.

Similarly, Executive Order 11988 of May 24, 1977, prohibits non-water-dependent development in a floodplain unless there is no practicable alternative. This order

requires federal agencies to recognize the significant value of floodplains and to consider the public benefits that would be realized from restoring and preserving floodplains. The objective of Executive Order 11988 is avoidance, to the extent possible, of long- and short-term adverse impacts associated with occupancy and modification of the base floodplain (100-year floodplain) and the avoidance of direct and indirect support of development in the base floodplain wherever there is a practicable alternative.

The Lummi Title 15A FDPC prohibits any development in a floodway that would cause 100-year flood levels to rise. Also prohibited in a floodway are all new construction and substantial improvement of residential structures, as well as repair or improvement of existing structures, if the work will increase the ground floor area. The FDPC allows development in the flood fringe, but requires the following measures (among others) to minimize flood damage:

- The lowest floor of new and substantially improved residential structures, including an occupied basement, must be elevated at least one foot above the 100-year flood elevation. New construction, substantial improvements, and manufactured homes must be anchored;
- Construction and utility design should be consistent with minimizing flood damage;
- Subdivisions should be consistent with minimizing flood damage;
- Enclosed areas below the lowest floor of new and substantially improved residential structures should be designed to minimize structural damage; and
- New and substantially improved nonresidential structures must have their lowest floor elevated at least one foot above the 100-year flood elevation or be flood-proofed and designed to resist the forces of floodwaters up to this elevation.

Pursuant to Title 15A, in coastal high flood hazard areas, all new construction and substantial improvements must be elevated on pilings and columns so that the bottom of the lowest floor is elevated at least one foot above the 100-year flood level. The foundation must also be anchored to resist the total force of wind and water acting simultaneously on the whole structure. All new construction must also be located landward of the reach of ordinary high water. The use of fill for structural support and the alteration of sand dunes that would increase potential flood damage is prohibited.

Critical facilities (e.g., hospitals, schools, nursing homes, police stations, fire stations, and facilities for hazardous waste storage) must, to the extent possible, be located outside the Special Flood Hazard Area (SFHA, the area inundated by a 100-year flood). If constructed within the SFHA, they must be elevated three feet or more above the base flood elevation. Toxic substances must be protected from exposure to floodwaters and elevated access routes must be provided, to the extent possible, to all critical facilities.

Current land use on the Reservation is relatively compatible with flooding in the Nooksack River floodplain, but is relatively incompatible with flooding along the low-lying coastal zones. Historical agricultural use of the floodplain and an awareness of the flood risk have resulted in a low housing and commercial density in this area and in flood-proofing actions to reduce the probability of flood damage. Conversely, the desire for scenic waterfront properties and a lack of awareness or respect of flood hazards has resulted in a high housing density along the low-lying coastal zones of the Reservation. Most of the properties and many of the structures along the western Sandy Point

Peninsula and Neptune Beach shorelines lie within the coastal velocity zone designated on the 2004 FIRMs for the Reservation (FEMA Maps No. 53073C1155 D and 53073C1165 D, dated January 16, 2004). Based on these final FIRMs, field observations during flood events, and high-resolution topographic mapping, most of these residences are not in compliance with Title 15A provisions for flood damage reduction.

Critics of FEMA's flood management system, in particular the NFIP, have pointed out that it has actually led to increased flood damages in the United States. This occurs in part because the program encourages development in the floodplain and coastal zones by providing federally backed flood insurance for damages to houses and property within these areas. This financial safeguard for developing within flood-prone areas, along with a false sense of security from regulations and flood control structures that may not be adequate, imposes additional costs on both property owners and tax payers (Tillamook County 1996). To avoid such problems, it is important for land use plans and regulations to direct development to locations that are outside of flood-prone areas.

Flooding on the Reservation is strongly affected by land uses and floodplain management upstream from the Reservation. Whatcom County has jurisdiction over land use in much of the lowlands, west of the foothills and mountains of the Cascade Range. The forested uplands are regulated by either the state or federal governments. To meet requirements of the Washington State Growth Management Act, the Whatcom County Comprehensive Plan was adopted (Whatcom County 1997b). This plan includes the following policies:

- Discourage development in areas prone to flooding;
- Limit lands in the 100-year floodplains to low intensity land uses such as open space corridors or agriculture;
- Use the Whatcom County CFHMP as a basis to balance land use and flooding;
- Discourage expansion of urban growth areas into flood-prone areas;
- Encourage multi-purpose problem solving relative to flooding, aquifer recharge, improved water quality, water uses, and fish habitat;
- Development in flood-prone areas must meet additional standards to mitigate identified flood hazards; and
- Develop a comprehensive land use management program consistent with the findings and recommendations of the Whatcom County CFHMP (Whatcom County 1997a, 1999).

About 75 percent of the 20,000 acre Lower Nooksack River floodplain is zoned for agricultural use and about an additional ten percent is zoned for other open space uses. Thus 85 percent of the floodplain is zoned for flood-compatible uses. Retaining such uses is important not only to avoid flood damages but also to provide floodwater storage during large floods (Whatcom County 1997a). Whatcom County adopted floodplain regulations and entered the regular phase of the NFIP in 1977.

5.3.2.2 Proposed Mitigation Measures

Administration

In order to implement the Lummi Nation FDRP and to coordinate flood management activities with the Whatcom County Public Works Department (River and Flood Section), the Whatcom County Sheriff's Office, the Federal Emergency Management Agency, and the Corps of Engineers, the Lummi Nation recommends obtaining funding to provide for a 0.80 full-time equivalent (FTE) position. The Lummi Nation also recommends a benefit-cost analysis of implementation of the Community Rating System to qualify residents for discounts on NFIP premiums; funding for the 0.80 FTE would allow for such an analysis and potential implementation of the CRS. This funding would also assist in the administration of the NFIP and enforcement of the FDPC, which includes the inspection of structures and issuance of certifications that structures are constructed above the base flood elevation (BFE).

Short-Term Flood Mitigation Action No. 1: Identify funding to support a 0.80 FTE Hazard Mitigation Specialist, who would be responsible for coordinating the Multi-Hazard Mitigation Team and implementation of hazard plans.

Coordinating Organization: Natural Resources and Planning Departments

Timeline: ongoing

Plan Goals Addressed: Reduce Vulnerability, Implementation, Public Health and Safety, Improve Habitat

Protection of Existing Development in Flood-Prone Areas

Protection of new development from flooding is a necessary preventive solution to flooding, but this does not solve flooding and erosion problems for structures that have already been built in hazardous areas. These structures and properties receive protection from existing measures, including numerous levees and revetments and the Whatcom County flood warning and emergency response programs. However, the overall potential for flood damage remains high.

Mitigation alternatives for existing developments include the following:

- (1) Raise or flood-proof structures;
- (2) Relocate or buyout existing structures;
- (3) Construct flood control structures to protect properties;
- (4) Relocate manure lagoons; and
- (5) Do nothing.

Existing structures will need to be addressed on a case-by-case basis. The best alternative for each case will vary depending on the specific factors involved. The alternative chosen should have a positive benefit-cost analysis and should meet the applicable goals, objectives, and policies described in this plan.

Long-Term Flood Mitigation Action No. 1: Develop capability to use HAZUS-Multi-Hazard (MH) software to estimate potential losses and benefit-cost analysis software to analyze possible mitigation options. Develop list of projects prioritized by benefit-cost ratio and their importance to the Lummi Nation and its resources.

Ideas for Implementation

- Use software to analyze a test case and assess usefulness of the methods.
- As conditions change, update the project list.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: ongoing

Plan Goals Addressed: Reduce Vulnerability, Implementation, Public Health and Safety, Improve Habitat

Nooksack River

The Nooksack River regularly overtops the east and west bank levees below Ferndale during larger floods. Breaches of the levees along both sides have also occurred during most recorded large floods. The resulting floodwaters inundate farmlands, damage structures in the floodplain, threaten the Lummi Bay seawall, and cut off road access to the Lummi Peninsula and the Lummi Island ferry terminal. As described previously, the cost of damages and lost economic activity during such flooding is high.

Moving the west bank levees about 500 feet further from the river was a flood management alternative for the Nooksack River that was analyzed by Whatcom County using a computer model (Whatcom County 1997a). Such a large distance was chosen to evaluate whether using setback levees has merit for further consideration. The levee section considered was from just south of the Ferndale wastewater treatment plant to just south of Rayhorst Road and was evaluated at the current levee height. The model found that the average capacity increase along this river segment would be about 12,000 cfs. The improvement upstream was much less – only about 4,500 cfs at the treatment plant and about 3,000 cfs at the southern city limit of Ferndale. Thus the evaluated levee setback substantially increased river capacity along the setback segment, but the upstream benefit was not considered significant (Whatcom County 1997a).

The Whatcom County CFHMP describes three options for flood hazard management using flood control along the Nooksack River below Ferndale:

1. Keep the alignment and protection level of the levees essentially the same as they are today and allow historical flooding patterns to continue;
2. Construct a 100-year levee from Ferndale to Lummi Shore Road, along or west of Ferndale Road, that provides a wider flow corridor to Bellingham Bay and limits overflows to Lummi Bay; or
3. Strengthen and raise the existing west bank levees to prevent overflows to Lummi Bay.

Under the first option, the problems of Haxton Way inundation and associated isolation of the Lummi Peninsula and Lummi Island, potential damage to the Lummi Bay seawall, and inundation of floodplain properties would remain. To minimize dangerous and costly

levee breaches, improvements would be required to ensure levees are stable when overtopping occurs. This would involve selecting and designing the overflow locations.

The second option would require the compensation of property owners in the form of easements, buyouts, or relocation for some properties lying between the old levees and the new levee. About ten improved properties would be affected. The levee elevation required would be eight to nine feet higher than the existing elevations along Ferndale Road and ten to twelve feet higher than the ground elevations west of Ferndale Road. The estimated construction and total project costs are \$2.1 million and \$4.4 million for the Ferndale Road approach and \$1.5 million and \$3.1 million for the levee across agricultural land west of Ferndale Road (Whatcom County 1997a). If not already included, a bridge crossing the Lummi River channel should be a part of this project.

The third option would increase the flow through the east bank overflow corridor during large floods. Raising the existing west bank levees would have estimated construction and total project costs of \$1.1 million and \$2.3 million (Whatcom County 1997a).

The Whatcom County CFHMP recommends the second option. Under this option, existing agricultural levees along the west bank would remain overtoppable, but an overflow corridor would be in place to direct floodwaters to Bellingham Bay instead of Lummi Bay. Buyouts or flood-proofing would be required for properties in the overflow corridor. However, this option could avoid the cost of raising Haxton Way, reduce the probability of isolating the Lummi Peninsula and Lummi Island, and would not increase flood flow in the overflow corridor along the east bank (Whatcom County 1997a). The Lummi Nation FDRP adopted this option as a high priority mitigation action (LWRD 2001a).

To improve channel complexity, increase habitat quality and quantity for salmonids, and reconnect the river with the floodplain, the Lummi Nation supports moving the agricultural levees further from the river. This action would provide another increase in the flood capacity of the river channel and the flood storage of the floodplain.

The Whatcom County CFHMP recommendation to build a 100-year setback levee along Ferndale Road is in line with the priorities and policies of the Lummi Nation. Such a levee would create (according to the Whatcom County CFHMP) a regulatory floodway, which would require the buyout of at least ten improved properties in the floodway between the river and the new levee. Without the 100-year setback levee or in the event of a failure of such a levee, flood overflows would spread over the floodplain on the Reservation and would require elevation, relocation, or flood-proofing of the vulnerable existing structures in the floodplain. The Lummi Nation therefore recommends continued implementation of Title 15A FDPC regulations in the floodplain behind any future levee.

Although it would protect Haxton Way and Hillaire Road, failure of a 100-year levee along Ferndale Road could result in substantial damage to these roads, temporarily closing them. After floodwaters recede, closure of Haxton Way and Hillaire Road would leave Marine Drive (susceptible to further flooding) and the unimproved roadway along the Seapond Dike as the only road access to Lummi Peninsula until repair of Haxton Way or Hillaire Road occurred. Instead of only constructing a 100-year levee, the Lummi Nation recommends also raising Haxton Way to the level of the 100-year, future-conditions flood to provide access to the Lummi Peninsula during floods. Adequate flow

capacity under the road would be required and the Lummi Bay seawall may have to be modified to allow for the rapid release of floodwaters in case the 100-year levee is breached.

Long-Term Flood Mitigation Action No. 2: Obtain funding for construction of 100-year levee along Ferndale Road.

Ideas for Implementation

- Coordinate with FEMA and Whatcom County in pursuit of funding (Hazard Mitigation Grant Program, Flood Control Assistance Account Program).

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: ongoing

Plan Goals Addressed: Reduce Vulnerability, Partnerships and Implementation, Public Health and Safety

Slater Road

Slater Road is the primary transportation route from Interstate Highway 5 to the Reservation and the Silver Reef Casino, and is a primary transportation corridor to the industrial areas north of the Reservation (i.e., ConocoPhillips refinery, Alcoa-Intalco Works aluminum plant). It is inundated and closed on the east side of the Nooksack River even during small floods because it crosses the overflow corridor south of Tennant Lake. Large floods can close the road on both sides of the river for several days. The level of flood that closes Slater Road (approximately 27,000 cfs) closes Marine Drive as well, leaving the roads through or north of Ferndale as the only routes to the west side of the river.

Mitigation alternatives for Slater Road include the following:

1. Maintain the current elevation of the road, allowing periodic inundation;
2. Raise the roadway on the east bank and provide an 800-foot bridge to allow passage of floodwaters under the road; or
3. Raise the roadway to the 100-year level on both sides of the river and provide a bridge or causeway to allow passage of floodwaters on both sides of the river.

Since the Whatcom County CFHMP recommends maintaining the overflow corridor on the east side of the Nooksack River, the periodic closures of Slater Road and the resulting traffic congestion in Ferndale would continue under the first option. The second option, with an estimated total project cost of \$4.6 million, would keep the road open through the overflow corridor, but, during large floods, the road would still be inundated on the west side of the river. Since the second option represents an incomplete solution, the Whatcom County CFHMP recommended the first option in the short term and reconsideration of the second option in the future as traffic demands change and if special financing becomes available (Whatcom County 1997a; 1999). The third option, adopted as a long-term priority in the Lummi Nation FDRP (LWRD 2001a), would preserve overflow corridors on both sides of the river, maintain direct access to important economic areas both on and off the Reservation, protect public health and safety, and reduce traffic congestion in Ferndale.

Long-Term Flood Mitigation Action No. 3: Obtain funding for raising Slater Road and providing for underflow.

Ideas for Implementation

- Coordinate with FEMA and Whatcom County in pursuit of funding (Hazard Mitigation Grant Program, Flood Control Assistance Account Program). Also coordinate with industries at Cherry Point and the City of Ferndale.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: ongoing

Plan Goals Addressed: Reduce Vulnerability, Develop Partnerships, Implementation, Public Health and Safety, Improve Habitat

Lummi River

The Lummi River currently receives flow from the Nooksack River only at relatively high flow levels (greater than approximately 10,000 cfs). Water passes to the Lummi River through a four-foot culvert in the levee that is reportedly collapsed. The normal flow capacity of this culvert is less than the flow capacity of the Lummi River; its poor condition presumably reduces the flow further.

Mitigation alternatives for the Lummi River include the following:

1. Maintain the current flow capacity of the Lummi River diversion culvert;
2. Increase the flow capacity of the culvert to match the capacity of the Lummi River channel; and
3. Enlarge the Lummi River channel and increase the diversion from the Nooksack River.

Since the modest increase of Lummi River channel capacity to 4,600 cfs (less than ten percent of the November 1990 flood flow) would cost up to about \$15.8 million, it is not considered a cost-effective option (Whatcom County 1997a). The improvement recommended by the draft Lower Nooksack River Comprehensive Flood Hazard Management Plan (CFHMP) for the Lummi River is not to increase the river capacity, but instead to rehabilitate the existing culvert at the confluence with the Nooksack River, including a gate or similar flow control structure, and to modify downstream structures if necessary (Whatcom County 1997a).

Pursuant to LIBC Resolution 98-62, the Lummi Natural Resource Department has been evaluating the potential for a Nooksack Estuary Recovery Project (NERP). The NERP is a project to restore coastal wetlands and marshes on the Lummi Reservation, including the possible reconnection of the Lummi and Nooksack rivers (instead of the Lummi River only receiving Nooksack River water during high flows). In general, the NERP addresses hydromodification in the Lummi River and Nooksack River estuaries. If the historical flow is not restored to the Lummi River, increasing the flow capacity of the diversion culvert to match the capacity of the Lummi River channel may be a desirable action that would enhance the estuarine character of Lummi Bay. The poor water quality in the Nooksack River and the threat it represents to tribal shellfish beds in Lummi and Portage bays currently limits the feasibility of this option.

Consistent with the desire of the Lummi Nation to improve the quality of the Lummi River estuary (via the NERP) and the policy of reconnecting the river with the floodplain, this plan recommends increasing the flow in the Lummi River by repairing, maintaining, and possibly increasing the capacity of the culvert from the Nooksack River. Although contingent on improving the quality of Nooksack River water to protect tribal shellfish beds in Lummi Bay, such an action will reduce the downstream Nooksack River flood flow and reestablish a historic migration corridor for anadromous fish. If limited to the capacity of the Lummi River channel, the flow increase should not contribute to flooding in the floodplain. If flow is reestablished on a fairly regular (or even continuous) basis, it could improve habitat quality in the Lummi River and in the Lummi Bay estuary, but will reduce instream flow in the Nooksack River downstream from the Lummi River distributary.

Long-Term Flood Mitigation Action No. 4: Obtain funding for construction and maintenance of a new culvert from the Nooksack River to the Lummi River.

Ideas for Implementation

- Coordinate with FEMA and Whatcom County in pursuit of funding (Hazard Mitigation Grant Program, Flood Control Assistance Account Program).

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: ongoing

Plan Goals Addressed: Reduce Vulnerability, Develop Partnerships, Implementation, Public Health and Safety, Improve Habitat

Lummi Bay Seawall

The Lummi Bay seawall is threatened by overflows and levee breaches along the west bank of the Nooksack River. In 1998 the six non-functioning tide gates on the south side of the Lummi River, mounted on 36-inch corrugated steel culverts, were replaced by five concrete box culverts, four-feet-wide by six-feet-tall, fitted with “flapper” gates made out of aluminum. In addition, a fuse plug was added to the seawall on the south side of the Lummi River to provide for the release of impounded floodwater during a large flood. Three five-foot by five-foot box culverts drain the northern distributary channel of the Lummi River. Whether these two sets of culverts and the fuse plug will eliminate the hazard of a seawall breach during a large flood is not yet known. A 100-year levee along the west side of the river, as described in the previous section, would minimize this threat. If such a levee is not constructed, the following options would address a potential seawall breach:

1. Add more culverts with tide gates;
2. Construct additional, easily repairable fuse plugs in the seawall to accelerate floodwater drainage during severe flooding; or
3. Maintain the seawall as it exists.

Since the 100-year setback levee that was adopted as a high priority in the Lummi Nation FDRP and was recommended in the Whatcom County CFHMP would minimize the threat to the seawall, neither seawall project is recommended in the short term. Continued maintenance of the existing structure, culverts, and tide gates is recommended in anticipation of the construction of a 100-year levee.

Long-Term Flood Mitigation Action No. 5: Monitor condition of culverts, tide gates, and seawall and identify funding sources for potential maintenance or repairs.

Ideas for Implementation

- Coordinate with FEMA and Whatcom County to address necessary pre- and post-disaster repairs.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: ongoing

Plan Goals Addressed: Reduce Vulnerability, Develop Partnerships, Implementation, Public Health and Safety

Marine Drive

Marine Drive, which floods frequently and early in a flood, was raised after the 1990 floods to prevent inundation during small floods. However, raising the road had the effect of limiting floodwater passage and diverting more of the overflow toward Haxton Way. If existing levee protection is unchanged, lowering Marine Drive, or raising Marine Drive and providing for underflow, would allow more overflow to reach Bellingham Bay and thereby would reduce inundation of Haxton Way and pressure on the Lummi Bay seawall. The estimated total project cost for lowering Marine Drive is \$113,000 (Whatcom County 1997a).

Mitigation alternatives for Marine Drive include the following:

1. Maintain the current elevation of Marine Drive;
2. Lower the road surface to allow more overflow; or
3. Raise the road surface and provide for flow under the road.

Maintaining the current elevation of Marine Drive would result in a continued pattern of frequent closures during minor floods (six flood events closed the road for at least 19 days from Fall 2001 through Summer 2002). Lowering the road surface would result in more frequent closures of Marine Drive during the flooding season. The benefits of raising the road surface across the full width of the floodplain and providing underflow include reducing or eliminating road closures, providing a shorter route for emergency response vehicles to travel to the Lummi Peninsula and to the hospital in Bellingham, and possibly providing a significant habitat improvement value west of Kwina Slough. If Marine Drive is raised, the elevation of the road west of Kwina Slough should match the elevation of the 100-year setback levee proposed for along Ferndale Road. If road access to the Lummi Peninsula via Haxton Way is protected by a 100-year setback levee or by the raising of Haxton Way (a more heavily used road), or if 24-hour emergency response capabilities are established on the Lummi Peninsula, then keeping Marine Drive open during large floods becomes a lower priority.

The Whatcom County CFHMP recommends maintaining the Marine Drive approach to the bridge over the Nooksack River at the current elevation. This would allow continued overtopping and the resulting road closures during relatively minor floods. Lowering the roadway provides little benefit if the recommended 100-year setback levee along Ferndale Road is constructed to control overflows to Lummi Bay or if Haxton Way is

raised (Whatcom County 1999). The Lummi Nation favors raising Marine Drive and providing for flow under the road (LWRD 2001a).

Long-Term Flood Mitigation Action No. 6: Obtain funding for raising Marine Drive and providing for underflow.

Ideas for Implementation

- Coordinate with FEMA and Whatcom County in pursuit of funding (Hazard Mitigation Grant Program, Flood Control Assistance Account Program).

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: ongoing

Plan Goals Addressed: Reduce Vulnerability, Develop Partnerships, Implementation, Public Health and Safety, Improve Habitat

Haxton Way

Haxton Way, the primary route onto the Lummi Peninsula and to the ferry terminal and ferry that provide access to Lummi Island, is inundated by floodwaters that overflow or breach the west bank levees of the Nooksack River. Access to the peninsula and island can be cut off for days during a large flood.

Mitigation alternatives for Haxton Way include the following:

1. Maintain the current elevation of the road, allowing periodic inundation;
2. Raise 7,000 feet of the roadway, with bridges or culverts included in the project to allow passage of floodwaters under the road and improve salmon habitat;
3. Protect the road with a 100-year setback levee along Ferndale Road.

The periodic inundation of Haxton Way and the resulting isolation of the Lummi Peninsula and Lummi Island are a threat to public health and safety, especially in the case of a medical emergency among the approximately 3,000 people in the area. The loss of road access to the area also has a substantial economic cost, both from a reduction of business and from employees unable to get to work. These reasons, combined with effects in other areas of the west bank floodplain, make the first option (maintaining existing elevation) undesirable.

The project described in the second option (making the roadway a causeway) has an estimated construction cost of \$1.8 million and total project cost of \$3.8 million (Whatcom County 1997a, 1999). While this project would solve the access problem, other floodplain problems would remain, including extended inundation of agricultural lands and a threat to the Lummi Bay seawall. A comprehensive solution to these problems is preferable.

The Whatcom County CFHMP recommends the third option, which would protect Haxton Way, the seawall, and much of the floodplain with a 100-year levee at a cost that is comparable to the cost of raising Haxton Way. However, the Whatcom County CFHMP also recommends that until this option is accepted and implemented, it may be appropriate to raise the lowest sections of Haxton Way to prevent periodic inundation in the interim period (Whatcom County 1999). The Lummi Nation FDRP adopted the

second option as a short- and long-term priority, protecting the road both before a 100-year levee is built and in the case of a future 100-year levee failure (LWRD 2001a).

Long-Term Flood Mitigation Action No. 7: Obtain funding for raising Haxton Way and providing for underflow.

Ideas for Implementation

- Coordinate with FEMA and Whatcom County in pursuit of funding (Hazard Mitigation Grant Program, Flood Control Assistance Account Program).

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: ongoing

Plan Goals Addressed: Reduce Vulnerability, Develop Partnerships, Implementation, Public Health and Safety, Improve Habitat

Summary of Road Recommendations

In its adopted FDRP (LWRD 2001a), the Lummi Nation recommends raising Ferndale Road by constructing a 100-year setback levee that extends along Ferndale Road from Ferndale to Kwina Slough, then along the north side of Kwina Slough to Marine Drive, and finally along Marine Drive to Lummi Shore Road. The levee should include a bridge over the Lummi River channel where Ferndale Road crosses the river and culverts allowing flow under Marine Drive. This levee will prevent the inundation of the Nooksack River floodplain on the Reservation and thereby protect Haxton Way, which in turn will maintain road access to the Lummi Peninsula during large floods. The Lummi Nation also recommends raising Slater Road to the 100-year flood level both east and west of the Nooksack River and using bridges to allow floodwaters to pass downstream, underneath the roadway. This action will keep an important transportation corridor open during floods and will thereby minimize the economic impact of flooding. Finally, the Lummi Nation supports raising Haxton Way to the 100-year flood level and providing for the flow of floodwaters under Haxton Way. This action will provide access to the Lummi Peninsula and Lummi Island in case of a breach of the 100-year setback levee along Ferndale Road and Marine Drive.

Development and Land Use in Flood-Prone Areas

As described in Section 3.1.3, the Lummi Planning Department is developing a Comprehensive Plan for the Lummi Reservation. This plan will modify the existing zoning map and identify areas that will be developed for residential, commercial, industrial, and agricultural purposes, as well as showing areas that require protection (e.g., Special Flood Hazard Areas [SFHA], wetlands, and aquifer recharge zones). The Comprehensive Plan; the Land Use, Development, and Zoning Code; the Flood Damage Prevention Code (Title 15A); the Coastal Zone Management Plan; and the Water Resources Protection Code will reduce flood damage by ensuring that land use is compatible with the landscape, that infrastructure is developed in a coordinated fashion, and that development in SFHAs is minimized and flood-protected. In addition to continuing to administer all other existing regulations that protect development from flooding, the Lummi Nation should consider implementation of the Community Rating System (CRS) once Flood Insurance Rate Maps are approved for the Reservation. Implementing the CRS will provide a reduction in flood insurance premiums to residents

of jurisdictions that implement various flood regulations and other measures to prevent flood damage (much of which has already occurred on the Reservation).

One solution to the potential problem of increased future flood levels is to require higher elevation of the first floor of new structures within the floodplain. A safer standard is to require that all new structures be elevated or flood-protected to an elevation of three feet above the FIRM base flood level within the 100-year floodplain and to an elevation of one foot above the flood elevation within the designated 500-year floodplain (not yet determined for the Reservation).

Mitigation alternatives for development and land use include the following:

1. Retain the current standards in Title 15A of the Lummi Nation Code of Laws;
2. Increase the standards in Title 15A;
3. Prohibit new development in high hazard areas and restrict development in other flood-prone areas to flood-compatible land uses unless there is no practicable alternative;
4. Build a 100-year setback levee with three feet of freeboard along Ferndale Road; or
5. Combination of the above.

An analysis of future-condition flood levels and of the cost-benefit ratio of increasing development standards would be necessary in order to choose the best alternative listed above.

Long-Term Flood Mitigation Action No. 8: After modeling of Nooksack River flooding is completed by Whatcom County, analyze flood levels under future conditions of land use and assess the benefits of more protective development standards.

Ideas for Implementation

- Coordinate with Whatcom County to review models of Nooksack River flooding and to analyze the benefit-cost ratios of various development standards.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: ongoing

Plan Goals Addressed: Reduce Vulnerability, Develop Partnerships, Implementation, Public Health and Safety

Low-Lying Coastal Areas

In coastal areas subject to hazardous velocity flows, the Lummi Nation recommends the enforcement of the restrictions in the Title 15A FDPC for new development and a program of buyout or relocation of vulnerable existing structures. Restrictions on new structures will keep the problem from getting worse and the program for existing structures (probably implemented in response to damaging future floods) will avoid perpetuating the problem (LWRD 2001a).

In areas subject to flooding but not velocity hazards, the Lummi Nation recommends elevation or flood-proofing of new and existing development as described in Title 15A. These coastal floodplain areas are shown in Figure 5.1. The assessment of potential mitigation projects for existing development in coastal areas of the Reservation is addressed by Long-Term Flood Mitigation Action No. 1.

5.3.3 Earthquakes

Earthquake damage occurs because structures are built that cannot withstand severe shaking. Buildings, airports, schools, and lifelines (e.g., highways and utility lines) suffer damage in earthquakes. Damage can be very severe if structures are not designed to withstand shaking, are on ground that amplifies shaking, or ground that liquefies because of shaking. Unreinforced masonry buildings are known to be the most susceptible to damage.

While it is possible to design structures to withstand earthquakes, it can be prohibitively expensive to design for significant events. Most new buildings are currently designed with sufficient integrity for the occupants to safely survive the event and evacuate, but not necessarily to protect the building from damage. Thus, the main advantage of improved seismic design requirements is that they can protect lives as well as maintain the functionality of the structure in lesser magnitude events. Buildings that were not built to an adequate seismic standard can often be retrofitted and strengthened to help withstand earthquakes and provide personal safety. Further, developing knowledge of seismic hazards in specific areas before development can potentially reduce or prevent property destruction and loss of lives.

Since the Reservation faces an infrequent but significant earthquake hazard, identifying seismic-prone locations, adopting strong policies, implementing damage reduction measures, and utilizing other mitigation techniques are essential to reducing risk from seismic hazards on the Reservation. This section describes current and proposed mitigation actions on the Reservation.

5.3.3.1 Current Mitigation Actions

The LIBC originally adopted a Building Code, Title 22 of the Lummi Nation Code of Laws, on January 5, 1968; an amended code was adopted in January 2004. The original Building Code adopted the Uniform Building Code (UBC) of the International Conference of Building Officials (1975) by reference to govern construction within all areas of the Reservation. Thus when the Uniform Building Code is updated, the changes take effect immediately on the Reservation. The UBC includes earthquake standards that are scaled to the earthquake hazard of an area; the Lummi Reservation is in Seismic Zone 3 (Southern California is in the highest zone, Zone 4). In the near future, the Lummi Nation plans to adopt the International Building Code, which applies seismic design standards based on peak ground acceleration (PGA) values instead of seismic zones.

For construction of the Silver Reef Casino in the Floodplain area during 2001 and the casino expansion project during 2003, several actions were taken to mitigate the earthquake hazard posed by liquefaction. Soil borings and cone penetration tests (from 58 to 71 feet below the ground surface) were conducted to determine the potential for liquefaction. The high ground water table and loose sand and soft silt or clay layers that were found indicated that there was a high risk for liquefaction. Based on the results of these tests, GeoEngineers estimated that if there were no site improvements and a conventional foundation (i.e., shallow footings) were used, 4 to 6 inches of total settlement and 2 to 4.5 inches of differential settlement (the primary concern) could occur and lateral displacement was likely. To reduce the settlement potential, approximately 3-foot diameter columns of gravel and cobbles were placed to a depth of

20 feet below ground surface into the soils at regular intervals to strengthen the surrounding soil. Using this technique, less than 2 inches of total settlement and 0.5 to 1.5 inches of differential settlement could occur and lateral displacement is unlikely. Expected performance during the design earthquake is minor damage (LIBC 2001).

5.3.3.2 Proposed Mitigation Measures

Long-Term Earthquake Mitigation Action No. 1: Identify funding sources for structural and nonstructural retrofitting of structures that are identified as seismically vulnerable.

Ideas for Implementation

- Provide information to property owners, small businesses, and organizations regarding sources of funds (e.g., loans, grants); and
- Explore options for including seismic retrofitting in existing programs such as low-income housing, insurance reimbursements, and pre- and post-disaster repairs.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: ongoing

Plan Goals Addressed: Partnerships and Implementation, Public Awareness, Public Health and Safety

Long-Term Earthquake Mitigation Action No. 2: Encourage purchase of earthquake hazard insurance.

Ideas for Implementation

- Provide earthquake insurance information to Reservation residents; and
- Coordinate with insurance companies and organizations to produce and distribute earthquake insurance information.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: ongoing

Plan Goals Addressed: Protect Life and Property, Public Awareness

Long-Term Earthquake Mitigation Action No. 3: Encourage seismic strength evaluations of critical facilities on the Reservation to identify vulnerabilities for mitigation of schools, public infrastructure, and critical facilities to meet current seismic standards.

Ideas for Implementation.

- Develop an inventory of critical facilities that do not meet current seismic standards;
- Encourage owners of non-retrofitted reservoirs or water tanks to upgrade them to meet seismic standards; and
- Encourage all water providers to replace all old cast iron pipes with ductile iron, and identify partnership opportunities with other agencies for pipe replacement.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: 5 years

Plan Goals Addressed: Protect Life and Property, Emergency Services, Public Health and Safety

Long-Term Earthquake Mitigation Action No. 4: Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.

Ideas for Implementation

- Provide information to government building and school facility managers and teachers on securing bookcases, filing cabinets, light fixtures, and other objects that can cause injuries and block exits;
- Encourage facility managers, business owners, and teachers to refer to FEMA's practical guidebook: *Reducing the Risks of Nonstructural Earthquake Damage*;
- Encourage homeowners and renters to use *Is Your Home Protected from Earthquake Disaster? A Homeowner's Guide to Earthquake Retrofit* (IBHS) for economic and efficient mitigation techniques;
- Explore partnerships to provide retrofitting classes for homeowners, renters, building professionals, and contractors; and
- Target development located in potential fault zones or in unstable soils for intensive education and retrofitting resources.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: Ongoing

Plan Goals Addressed: Protect Life and Property, Public Awareness, Public Health and Safety

5.3.4 Severe Winter Storms

5.3.4.1 Current Mitigation Actions

- Early warning of storms is provided by the National Weather Service, the LIBC Safety Officer, Whatcom County DEM, radio, or television.
- Tribal offices and schools commonly close when roads are hazardous.
- During recent winter storms, the construction division of the Lummi Planning Department has coordinated road clearing with local contractors and with Whatcom County (Kamkoff 2003).
- Vulnerable citizens typically receive assistance from family members, friends, or neighbors.

5.3.4.2 Proposed Mitigation Measures

Mitigation actions should focus on providing public information on emergency preparedness and self-help, warning and notification of the public, prioritization of roads and streets to be cleared, provision of emergency services, mutual aid with other public entities, and procedures for requesting state and federal assistance if needed.

Short-Term Severe Winter Storm Mitigation Action No. 1: Enhance strategies for debris management for severe winter storm events.

Ideas for Implementation

- Develop coordinated management strategies for de-icing roads, plowing snow, ensuring utility service, clearing roads of fallen trees, and clearing debris from public and private property.

Coordinating Organization: Planning Department

Timeline: 2 years

Plan Goals Addressed: Partnerships and Implementation, Emergency Services, Public Health and Safety

Short-Term Severe Winter Storm Mitigation Action No. 2: Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public and private infrastructure from severe winter storms.

Ideas for Implementation

- Partner with responsible agencies and organizations to design and implement programs that reduce risk to life, property, and utility systems; and
- Develop partnerships between utility providers and local public works agencies to document known hazard areas and implement actions to ensure timely response.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: 2 years

Plan Goals Addressed: Emergency Services, Partnerships, and Implementation

Long-Term Severe Winter Storm Mitigation Action No. 1: Increase public awareness of severe winter storm mitigation measures.

Ideas for Implementation

- Collect, develop, and distribute public education materials for protecting life, property, and the environment from severe winter storm events;
- Distribute educational materials to Reservation residents and public and private sector organizations regarding evacuation routes during road closures; and
- Target the vulnerable populace for disseminating preparedness information.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: Ongoing

Plan Goals Addressed: Public Awareness, Protect Life and Property

5.3.5 Windstorms

5.3.5.1 Current Mitigation Actions

- The Uniform Building Code adopted by reference in the Lummi Nation Title 22 Building Code sets a wind design standard of 80 mph.
- Review of proposed projects by the LNR Forestry Manager as part of the land use permitting process may result in the recommended removal of hazardous trees or branches that are close to structures.
- Provisions in the Flood Damage Reduction Code will reduce impacts due to the wind-driven waves that cause coastal flooding.

5.3.5.2 Proposed Mitigation Actions

The primary ways to reduce direct damage from high winds is to build wind-resistant structures and to keep debris, particularly trees, from falling onto the structures. The Lummi Nation already has a building code with a wind speed standard, and works both through the land use permitting process and with local utility providers to reduce the

hazard presented by falling trees. High winds are also responsible for damage through coastal flooding. Therefore the proposed mitigation actions listed above for coastal flooding should also be considered as mitigation actions for windstorms.

Short-Term Windstorm Mitigation Action No. 1: Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.

Ideas for Implementation

- Collect, design, and disseminate useful education information to property owners to reduce risk from falling trees to life, property, and utility systems;
- Develop partnerships with utility providers to document known hazard areas and implement actions to ensure timely response; and
- Identify potentially hazardous trees and either remove or prune to reduce the hazard.

Coordinating Organization: Lummi Planning Department, Lummi Natural Resources Department

Timeline: 2 years

Plan Goals Addressed: Emergency Services, Partnerships, Implementation, Public Health and Safety

Short-Term Windstorm Mitigation Action No. 2: Enhance strategies for debris management after windstorm events.

Ideas for Implementation

- Develop coordinated management strategies for clearing roads of fallen trees, and clearing debris from public and private property.

Coordinating Organization: Lummi Planning Department

Timeline: 2 years

Plan Goals Addressed: Emergency Services, Partnerships, and Implementation

Long-Term Windstorm Mitigation Action No. 1: Support/encourage electrical utilities to use underground construction methods where possible to reduce power hazards and outages from windstorms.

Ideas for Implementation

- Increase the use of underground utilities where possible.
- Develop local utility to ensure timely response and repair.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: 5 years

Plan Goals Addressed: Natural Systems, Partnerships, and Implementation

Long-Term Windstorm Mitigation Action No. 2: Increase public awareness of windstorm mitigation activities.

Ideas for Implementation

- Provide public education materials for protecting life, property, and the environment from windstorm events; and

- Distribute educational materials to Reservation residents and public and private sector organizations regarding preparedness for loss of power.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: Ongoing

Plan Goals Addressed: Public Awareness, Protect Life and Property

5.3.6 Coastal Erosion

Coastal erosion has historically been addressed most often through structural means, which have sometimes exacerbated the problem by increasing erosion in front of or adjacent to the structure, such as can be seen along the Sandy Point Peninsula.

5.3.6.1 Current Mitigation Actions

- The Lummi Shore Road project, with its associated beach nourishment effort, stabilized the shoreline bluffs along Bellingham Bay.
- The rerouting of Lummi View Drive that is currently underway will reduce vulnerability along the bluff above Hale Passage.
- On-going monitoring will allow future problems to be anticipated.
- Review of land use permit applications by the Lummi Technical Review Committee provides an opportunity to direct new development away from vulnerable areas.

5.3.6.2 Proposed Mitigation Actions

The following mitigation measures are proposed to reduce coastal erosion damages along the shorelines of the Reservation. Mitigation actions for coastal flooding and for landslides also apply to coastal erosion.

Long-Term Coastal Erosion Mitigation Action No. 1: Continue monitoring of erosion rates along the Reservation shorelines.

Ideas for Implementation

- Complete evaluation of all Reservation shorelines and monitor eroding reaches to gain understanding of the processes generating the erosion.

Coordinating Organization: Lummi Water Resources Division, Lummi Planning Department

Timeline: Ongoing

Plan Goals Addressed: Protect Life, Property, and Natural Resources; Public Awareness

Long-Term Coastal Erosion Mitigation Action No. 2: Redirect and/or relocate development away from eroding shorelines.

Ideas for Implementation

- Regulate construction near the shoreline under the existing Land Use, Development, and Zoning Code, CZMP, and Flood Damage Prevention Code.
- Use the opportunity of disaster funding to relocate structures away from the shoreline.
- Develop a pre-disaster program of property acquisition and removal of structures.

Coordinating Organization: Lummi Planning Department, Lummi Natural Resources Department
Timeline: Ongoing
Plan Goals Addressed: Protect Life, Property, and Natural Resources; Public Awareness

5.3.7 Drought

In general, drought effects on domestic and municipal water supplies are historically corrected by building another reservoir, a larger pipeline, a new well, or some other facility. Short-term measures, such as using large capacity water tankers to supply domestic potable water, have also been used.

5.3.7.1 Current Mitigation Actions

Proper management of water resources can reduce the damages that may otherwise result from a drought. Drought information collection assists in the response to a drought and in the formulation of programs for future droughts. Drought forecasting information and mitigation strategies used in Washington State that may influence the effects of a drought on the Reservation include (WEMD 2001):

- Irrigation before a forecasted drought
- Advance warning of changes in stream flows
- Measurement of snow pack conditions
- Limit irrigation and sprinkling
- Study of ground water supplies
- Shut down of logging operators
- Water conservation measures
- Reduce hydroelectric power use
- Voluntary energy conservation programs
- Purchase of out-of-region energy
- Apply for federal drought relief programs
- State drought legislation
- Consider emergency supplemental ground water permits

The Lummi Water Resources Division has an on-going ground water monitoring program that tracks water levels in Reservation aquifers. This effort is improving the understanding of water resources on the Reservation and will help manage potential water shortages in the future. In addition, the LWRD is currently developing a Lummi Nation Water Conservation Plan that will include actions applicable to reducing drought effects.

5.3.7.2 Proposed Mitigation Actions

Long-Term Drought Mitigation Action No. 1: Implement the mitigation actions recommended in the Lummi Nation Water Conservation Plan, both before and after drought conditions occur.

Coordinating Organization: Lummi Water District, Lummi Water Resources Division
Timeline: Ongoing

Plan Goals Addressed: Protect Economic Interests, Environmental Quality

Long-Term Drought Mitigation Action No. 2: Protect the senior water rights of the Lummi Nation in the Nooksack River watershed.

Coordinating Organization: LIBC, Lummi Natural Resources Department

Timeline: Ongoing

Plan Goals Addressed: Protect Economic Interests, Environmental Quality

5.3.8 Wildfire

Building in or near woodlands increases the potential loss from wildfires. Structures are often built with minimal awareness of the need for protection from wildfires. Public education about reducing hazards from wildfires and planning escape routes is necessary. Early-warning systems are essential to save lives. There are a number of ways to reduce wildland fires and minimize injury and property loss. Potential mitigation activities include (WEMD 2001):

- Develop ordinances and educate people regarding wildfire risks and mitigation measures;
- Develop fire detection programs and emergency communications systems;
- Exercise warning systems and evacuation plans;
- Road closures during fires;
- Woodland property owner precautions:
 - Maintain appropriate defensible space around homes
 - Provide access routes and turnarounds for emergency equipment
 - Minimize fuel hazards adjacent to homes
 - Use fire-resistant roofing materials
 - Maintain water supplies
 - Ensure that home address is visible to first responders

5.3.8.1 Current Mitigation Actions

Since the probability of a damaging wildfire on the Reservation is relatively low, the few current mitigation actions for wildfire are:

- The LNR Forestry Manager implements a ban on open burning when conditions are appropriately dry.
- Fire hydrants, sufficient water storage, and water pressure are maintained in developed areas, although some isolated homes are too far from hydrants for them to be used.
- There are three fire stations on the Reservation, one each in the main forested areas of the Reservation.

5.3.8.2 Proposed Mitigation Actions

Short-Term Wildfire Mitigation Action No. 1: Educate LIBC personnel on federal cost-share and grant programs, Fire Protection Agreements, and other related federal programs so the full array of assistance available is understood.

Ideas for Implementation:

- Investigate potential funding opportunities for individual mitigation projects;
- Develop, approve, and promote Fire Protection Agreements and partnerships to clarify roles and responsibilities and to provide for fire mitigation activities and suppression preparedness; and
- Ensure adequate water storage to meet increasing demands for water.

Coordinating Organization: LIBC Funding Department, Multi-Hazard Mitigation Team, Lummi Water District

Timeline: 1-2 years

Plan Goals Addressed: Protect Life and Property, Public Awareness

Short-Term Wildfire Mitigation Action No. 2: Inventory alternative firefighting water sources and encourage the development of additional sources.

Ideas for Implementation:

- Advocate for water storage facilities with fire-resistant electrical pump systems in developments outside of fire protection districts that are not connected to a community water or hydrant system; and
- Develop a protocol for fire jurisdictions and water districts to communicate all hydrant outages and water shortage information.

Coordinating Organization: Multi-Hazard Mitigation Team, Lummi Water District, Lummi Planning Department

Timeline: 1 year

Plan Goals Addressed: Protect Life and Property

Long-Term Wildfire Mitigation Action No. 1: Enhance outreach and education programs aimed at mitigating wildfire hazards and reducing or preventing the exposure of citizens, public agencies, private property, and businesses to wildfire.

Ideas for Implementation:

- Visit urban interface neighborhoods and rural areas and conduct education and outreach activities;
- Conduct specific community-based demonstration projects of fire prevention and mitigation in the urban interface;
- Establish neighborhood “drive-through” activities that pinpoint site-specific mitigation activities. Fire crews can give property owners personal suggestions and assistance; and
- Perform public outreach and information activities at Reservation fire stations by creating “Wildfire Awareness Week” activities. Fire stations can hold open houses and allow the public to visit, see the equipment, and discuss wildfire mitigation with the station crews.

Coordinating Organization: Multi-Hazard Mitigation Team, Individual Fire Departments

Timeline: Ongoing

Plan Goals Addressed: Protect Life and Property, Public Awareness

Long-Term Wildfire Mitigation Action No. 2: Increase communication, coordination, and collaboration between wildland/urban interface property owners, tribal planners, and fire

prevention crews and officials to address risks, existing mitigation measures, and federal assistance programs.

Ideas for Implementation:

- Encourage single-family residences to have fire plans and practice evacuation routes;
- Encourage fire inspections in residential homes by fire departments to increase awareness among homeowners and potential fire responders;
- Require fire department notification of new business applications to ensure that appropriate fire plans have been developed;
- Work closely with landowners and/or developers who choose to build in the wildland/urban interface to identify and mitigate conditions that aggravate wildland/urban interface wildfire hazards, including:
 - Ensure the width and grade of roadways is adequate to provide access for emergency equipment;
 - Ensure adequate water supplies;
 - Ensure adequate fuel breaks and a defensible space through the spacing, consistency, and species of vegetation around structures;
 - Avoid highly flammable construction materials;
 - Ensure building lots and subdivisions are in compliance with tribal land use/fire protection regulations; and
 - Ensure adequate entry/escape routes.
- Encourage all new homes and major remodels involving roofs or additions that are located in the interface to have fire-resistant roofs and residential sprinkler systems.

Coordinating Organization: Multi-Hazard Mitigation Team, Individual Fire Departments

Timeline: Ongoing

Plan Goals Addressed: Protect Life and Property, Public Awareness, Emergency Services, Partnerships, and Implementation

Long-Term Wildfire Mitigation Action No. 3: Encourage implementation of wildfire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability.

Ideas for Implementation:

- Employ mechanical thinning and prescribed burning to abate the risk of catastrophic fire and restore the more natural regime of higher frequency, low-intensity burns. Prescribed burning can provide benefit to ecosystems by thinning hazardous vegetation and restoring ecological diversity to areas homogenized by invasive plants; and
- Clear trimmings, trees, brush, and other debris completely from sites when performing routine maintenance and landscaping to reduce fire risk.

Coordinating Organization: Multi-Hazard Mitigation Team, LNR Forestry Manager, Individual Fire Departments

Timeline: Ongoing

Plan Goals Addressed: Natural Systems

5.3.9 Landslide

Landslide problems are often compounded by poor land use management practices. Applying established ordinances where geological hazards have been identified will prevent some landslide losses. However, the Reservation already has several areas of established homes that are above or below unstable slopes. Careful maintenance of vegetation on slopes, prevention of erosion, engineered drainage of slopes, and other mitigation using qualified expertise is necessary to protect these areas.

5.3.9.1 Current Mitigation Actions

- Monitoring of coastal erosion to provide information on shoreline areas susceptible to future landslides.
- Review of land use permit applications by the TRC provides an opportunity to reduce erosion and loading of slopes by improper drainage.

5.3.9.2 Proposed Mitigation Actions

Short-Term Landslide Mitigation Action No. 1: Continue to improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in landslide-prone areas.

Ideas for Implementation

- Develop public information to emphasize economic risk when building on potential or historical landslide areas.

Coordinating Organization: Multi-Hazard Mitigation Team, Lummi Natural Resources Department, Lummi Planning Department

Timeline: 2 years

Plan Goals Addressed: Protect Life and Property, Public Awareness

Short-Term Landslide Mitigation Action No. 2: Encourage construction and subdivision design that can be applied to sloped areas to reduce development effects on landslide vulnerability.

Ideas for Implementation

- Increase communication and coordination between the Lummi Planning Department divisions and developers.

Coordinating Organization: Lummi Technical Review Committee

Timeline: 3 years

Plan Goals Addressed: Protect Life and Property, Partnerships, and Implementation

Long-Term Landslide Mitigation Action No. 1: Limit construction in identified potential and historical landslide areas through regulation and public outreach.

Ideas for Implementation

- Analyze existing regulations regarding development in landslide-prone areas;
- Continue to use land use permitting process to review proposed projects in potential landslide areas;

- Conduct public outreach through appropriate channels (e.g., neighborhood associations, Squol Quol).

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: Ongoing

Plan Goals Addressed: Protect Life and Property, Public Awareness, Natural Systems

5.3.10 Tsunami

The tsunami hazard on the Reservation is similar in nature but potentially much larger in scale than the hazard associated with coastal flooding. Hence, the mitigation actions listed for coastal flooding also apply to the tsunami hazard. Structural losses and the threat to public health and safety can be reduced by discouraging further development in the primary hazard zones and by relocating existing homes. However, relocation may be difficult to implement since many owners may be reluctant to move. A public education effort is therefore very important to reduce the public health and safety hazard.

5.3.10.1 Current Mitigation Actions

- Adoption and implementation of the Flood Damage Prevention Code.
- Recent improvement of the Lummi Bay seawall.
- Development of this Multi-Hazard Mitigation Plan.

5.3.10.2 Proposed Mitigation Actions

Short-Term Tsunami Mitigation Action No. 1: Install tsunami warning and evacuation route signs in hazard areas.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: 1-2 years

Plan Goals Addressed: Protect Life and Property, Public Awareness

Short-Term Tsunami Mitigation Action No. 2: Provide residents in the hazard area with updated information on the tsunami hazard, including the probability of occurrence, potential size of the hazard, signs of an impending tsunami, and best route to avoid a tsunami.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: 1-2 years

Plan Goals Addressed: Protect Life and Property, Public Awareness

Long-Term Tsunami Mitigation Action No. 1: Use the availability of Pre-Disaster Mitigation funding to relocate or buyout vulnerable homes.

Ideas for Implementation

- Prepare a relocation/buyout plan to be ready for opportunity of future HMGP funds.

Coordinating Organization: Multi-Hazard Mitigation Team

Timeline: On-going

Plan Goals Addressed: Protect Life and Property, Reduce Future Vulnerability

5.3.11 Volcano

Preparedness and land use planning are important for mitigation of volcanic hazards. Reducing population growth in paths of lahars, implementing warning systems, and planning evacuations can lower the potential loss of life and property during future eruptions.

5.3.11.1 Current Mitigation Actions

Federal, state, and local governments have joined to develop a volcanic hazard plan that addresses issues of emergency response and strategies for mitigation and expanded public awareness. The Mount Baker-Glacier Peak Coordination Plan is designed to coordinate efforts between governmental agencies if volcanic activity occurs at Mount Baker or Glacier Peak, Washington (Mount Baker/Glacier Peak Facilitating Committee, undated). Mitigation actions in this plan include:

- Continuous monitoring of the areas around Mount Baker by the Pacific Northwest Seismograph Network, which is jointly operated by the University of Washington and the USGS. The first indications of volcanic unrest at Mount Baker will likely be an increase in earthquake activity, and it will likely take days to weeks to decide whether the increase is the result of magma movement towards the surface or not.
- In response to developing volcanic activity, a USGS response team expects to:
 - Establish a temporary volcano observatory at or near an Emergency Operations Center in Whatcom or Skagit County. The observatory will maintain close contact with emergency managers and will be sited to allow efficient daily helicopter access to the volcano. The primary function of the USGS response team is to monitor all volcanic developments and provide eruption forecasts and hazard assessment information to support decisions by public officials.
 - Install monitoring instruments to collect and analyze visual, seismic, lahar detection, deformation, and gas emission data. As an important element of redundancy, critical seismic data will be received and analyzed both at the University of Washington and the local temporary volcano observatory.
- Among other activities listed in the plan, the Whatcom County Division of Emergency Management would implement an Emergency Operation Plan and activate and maintain an Emergency Operations Center.

5.3.11.2 Proposed Mitigation Actions

For a variety of reasons, hazardous magmatic eruptions at Mount Baker will probably be preceded by weeks or more of activity. In addition, the most significant volcanic hazard that may affect the Reservation, a lahar, would take on the scale of hours to reach the Reservation. Residents on the Nooksack River floodplain would therefore have sufficient time to avoid a potential lahar. Since the effects of a lahar, by the time it reached the Reservation, would be similar to that of a Nooksack River flood, the proposed mitigation actions for volcanic lahars that threaten the Reservation are the same as described for Nooksack River flooding in Section 5.3.2.

5.4 MITIGATION PRIORITIES

5.4.1 All Hazards

Short Term:

1. Establish a Multi-Hazard Mitigation Team;
2. Promote the establishment and maintenance of home survival/emergency kits; and
3. Establish 24-hour emergency medical response capability located on the Reservation.

Long Term:

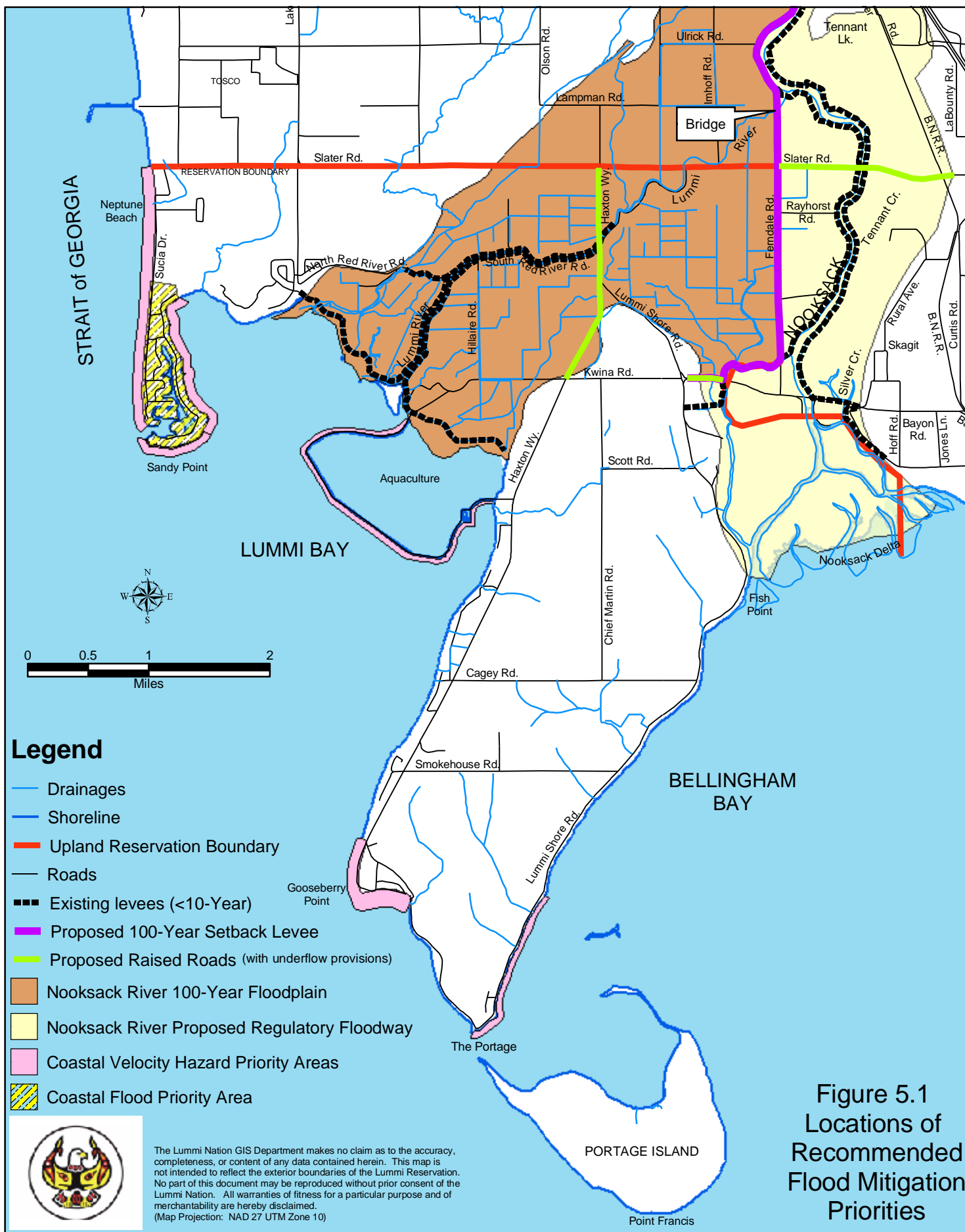
1. Pursue funding for the Lummi Nation mitigation priorities and recommendations described in this MHMP, including funding for needed staff and infrastructure;
2. Improve and sustain public education programs aimed at mitigating natural hazards;
3. Redirect and/or relocate development away from hazard areas.

5.4.2 Floods, Tsunamis, and Volcanic Lahars

The following are specific long-term priorities on the Reservation, in order of importance (LWRD 2001a):

1. Protect the Nooksack River floodplain on the Reservation and maintain access to the Lummi Peninsula by constructing a 100-year setback levee that extends along Ferndale Road from Ferndale to Kwina Slough, then along the north side of Kwina Slough to Marine Drive, and finally along Marine Drive to Lummi Shore Road (the levee should include a bridge over the Lummi River channel and culverts allowing flow under Marine Drive);
2. Reduce the potential for flood damage along the low-lying coastal areas and concurrently reduce damage done to shoreline resources by bulkheads through the acquisition or relocation of flood-prone structures currently located in the coastal velocity zones;
3. Raise Slater Road to the 100-year flood level both east and west of the Nooksack River and use bridges or causeways to allow floodwaters to pass downstream;
4. Protect, acquire, or relocate vulnerable structures in the coastal and riverine floodplains, outside of the velocity zone and floodway, respectively; and
5. Provide access to the Lummi Peninsula in the case of levee failure by raising Haxton Way and providing for the flow of floodwaters under Haxton Way (this could serve as an interim measure prior to construction of a 100-year setback levee).

The locations of the specific priorities listed above are shown in Figure 5.1.



5.4.3 Other Hazards

Long Term:

1. Encourage seismic strength evaluations of schools, public infrastructure, and critical facilities on the Reservation to identify vulnerabilities for mitigation to meet current seismic standards.
2. Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.
3. Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.
4. Continue monitoring of erosion rates along the shorelines of the Reservation.
5. Limit construction in identified landslide areas and encourage construction and subdivision design that can be applied to sloped areas to reduce development effects on landslide vulnerability.
6. Install tsunami warning and evacuation route signs in hazard areas and provide residents in the hazard areas with updated information on the tsunami hazard, including the probability of occurrence, potential size of the hazard, signs of an impending tsunami, and best route to avoid a tsunami.

5.5 MITIGATION FUNDING SOURCES

In this section, current and potential sources of federal, tribal, state, local, or private funding for mitigation activities are identified. This plan, which was funded by a PDM planning grant from FEMA, may help the Lummi Nation acquire funding from the following programs or agencies:

- **Pre-Disaster Mitigation Program**, which provides funds to develop mitigation plans and implement mitigation projects, is administered by FEMA (by submitting a state-level plan, the Lummi Nation will qualify as a direct grantee);
- **Hazard Mitigation Grant Program**, which provides post-disaster funds for hazard reduction projects (e.g., elevation, relocation, or buyout of structures), is administered by the Washington State Emergency Management Division (by submitting this hazard mitigation plan to the state, the Lummi Nation will qualify as a sub-grantee);
- **Flood Control Assistance Account Program**, which provides funds for developing flood hazard management plans, for flood damage reduction projects and studies, and for emergency flood projects (e.g., repair of levees), is administered by the Washington State Department of Ecology (Ecology);
- **Flood Mitigation Assistance Program**, which provides funds for flood mitigation on buildings that carry flood insurance and have been damaged by floods, is administered by FEMA;

- **Department of Homeland Security funding**, in addition to FEMA programs;
- **U.S. Fire Administration**, which provides wildfire program funds;
- **Environmental Protection Agency**, which could provide funds for projects with dual hazard mitigation and environmental protection goals as well as updates to this MHMP and related planning efforts such as spill prevention and response planning;
- **Indian Health Service**, which could provide funds for hazard mitigation projects that address public health and safety;
- **Rural Development Agency, USDA**, which provides loan and grant funds for housing assistance, business assistance, community development, and emergency community water and wastewater assistance in areas covered by a federal disaster declaration;
- **Community Development Block Grant**, which provides funds for a variety of community development projects, is administered by the Department of Housing and Urban Development;
- **Small Business Administration Loans**, which help businesses recover from disaster damages, is administered by the Small Business Administration; and
- **Bureau of Indian Affairs**, which provides funds to support tribal activities.

In the past, Reservation residents and the Lummi Nation have received disaster relief funds from FEMA directly, or indirectly through the programs administered by Washington State. In addition, the Lummi Nation has secured grant funding from FEMA to develop a Flood Damage Reduction Plan and this Multi-Hazard Mitigation Plan.

Local potential funding sources for pre-disaster mitigation activities on the Reservation are very limited. Currently, the only potentially significant sources are the LIBC and the Silver Reef Casino. However, the LIBC has a very limited tax base (essentially only employment/income taxes, permit fees, and license fees as no property taxes are collected on trust properties and taxes on fee land are collected and retained by Whatcom County) and largely relies on funding from annual appropriations negotiated through the Bureau of Indian Affairs Office of Self-Governance and grant funds from other federal and state agencies. Profits from the Silver Reef Casino are distributed through a prioritized system to various community programs. This distribution is based on initial casino profits being used to repay loans secured to build the casino and the remainder allocated pursuant to a formula approved by the LIBC. This allocation has been described as a “waterfall” where, depending on profit levels, available funding is provided to a specific program up to a specified amount. If available profits exceed the specified amount for the first priority program, funding is provided to the second priority program to its specified limit. If profits exceed this amount, the third prioritized program is funded to its limit. This allocation method is repeated until the profits are fully allocated. The most likely future use of such funds to support hazard mitigation is property acquisition, but hazard mitigation is not specifically identified as a target for LIBC casino profits. As a result, financial support for hazard mitigation projects will largely rely on off-Reservation sources in the foreseeable future.

The ability of private citizens on the Reservation to pay for mitigation measures is also limited. While the per capita income of non-tribal residents generally exceeds that of surrounding Whatcom County, the median per capita income of tribal members (\$17,000; LIBC 2003) is significantly lower than the median income of Whatcom County residents. Hence, the ability of many tribal members to pay for hazard mitigation is very limited, and hazard mitigation may fall very low on the priority list for people struggling to pay for food, housing, energy, and other basic necessities.

There are other private companies and public agencies that could potentially help fund pre-disaster mitigation projects on or near the Reservation. Local public agencies and private companies that could fund such projects include Whatcom County, the City of Ferndale, and local businesses (most likely the two oil refineries and the aluminum plant just north of the Reservation). All of these organizations would benefit from some of the mitigation projects proposed in this plan (e.g., raising Slater Road).

5.6 MITIGATION ACTION PLAN

The following actions are proposed to meet the Lummi Nation's goals and objectives for hazard mitigation:

1. Establish and maintain a Multi-Hazard Mitigation Team comprised of representatives from pertinent LIBC departments and other organizations on the Reservation;
2. Pursue funding for the Lummi Nation mitigation priorities and recommendations described above, including funding for needed staff and infrastructure;
3. Approve a Comprehensive Plan that is aligned with the provisions of the Title 15A Flood Damage Prevention Code, the FDRP, the CZMP, the Title 17 Water Resources Protection Code, other hazard-related ordinances, and the recommendations of this MHMP;
4. Coordinate hazard planning, as appropriate, with other jurisdictions and review any actions proposed for the Nooksack watershed that may affect flooding on the Reservation (i.e., all proposed actions);
5. Review and possibly amend the Flood Damage Prevention Code in response to an analysis of future-conditions flood levels and flood management actions implemented throughout the Nooksack River watershed;
6. Review potential participation in the Community Rating System and, if desirable and practicable, continue to take appropriate actions to earn points toward discounts of flood insurance premiums for residents of the Reservation;
7. Continue to review hazard maps for accuracy and any changes in the estimated vulnerability of the Reservation;
8. Coordinate LIBC emergency response efforts with other appropriate jurisdictions and agencies; and
9. Implement a public education effort that will inform residents of the potential hazards.

6. LOCAL MITIGATION PLANNING COORDINATION

The LIBC is the sole governing body with specific jurisdiction over the Lummi Reservation. Hence, unlike a state, there are no local jurisdictions within the Reservation that have a responsibility to develop a multi-hazard mitigation plan as required by the Disaster Mitigation Act of 2000. Local public organizations on the Lummi Reservation (e.g., Lummi Water and Sewer District, Northwest Indian College, and the tribal schools) fall under the jurisdiction of the LIBC and will be served by this Multi-Hazard Mitigation Plan. These organizations will be encouraged to develop appropriate site plans or measures to prepare for and respond to the hazards that pose the greatest threats to people and buildings.

6.1 LOCAL FUNDING AND TECHNICAL ASSISTANCE

The Lummi Natural Resources (LNR) and Planning departments can provide various types of assistance to local organizations, businesses, or individuals that are trying to identify appropriate mitigation measures for their facilities. These include providing current hazard vulnerability estimates and technical information, improving communications between local organizations and hazard-related agencies, and coordinating hazard mitigation training. In addition, the proposed Multi-Hazard Mitigation Team (MHMT) can provide public education materials or presentations to organizations or residents on the Reservation. This team should proactively identify appropriate mitigation measures and present them to local organizations, businesses, and/or individuals.

The LIBC currently has limited funds to provide direct funding of mitigation measures to local entities. However, the LIBC can apply for and pass on funds from outside sources to local entities and/or implement activities that directly or indirectly help local organizations, businesses, and/or individuals implement mitigation measures.

6.2 LOCAL PLAN INTEGRATION PROCESS

Since this MHMP is intended to serve all organizations and individuals on the Reservation, the Lummi Nation does not anticipate integrating local mitigation plans into this MHMP. However, site plans or lists of mitigation measures or strategies developed by local organizations will be attached as appendices to revisions of this MHMP, which are required every three years. For example, it is anticipated that the Lummi Water and Sewer District will identify pertinent mitigation measures that can be attached to this plan. The MHMT, or its representatives from the LNR and/or Lummi Planning departments, will be responsible for compiling specific mitigation measures that are identified and implemented by local organizations.

The LIBC is currently developing an Emergency Management Response Plan to guide the actions of officials during hazard emergencies. This draft plan is attached as Appendix C. One goal of the Emergency Management Response Plan is to provide greater coordination between the LIBC and other local emergency services or emergency management agencies. In addition, the Lummi Natural Resources Department is developing a Spill Prevention and Response Plan to provide guidance to officials in case of a hazardous materials spill on or near the Reservation. The goal of these plans is to help the LIBC deliver a coordinated response to future natural and human-caused hazard events.

6.3 LOCAL ASSISTANCE PRIORITIZATION CRITERIA

With no local jurisdictions within the Lummi Indian Reservation, the Lummi Nation does not anticipate receiving grant applications under its Multi-Hazard Mitigation Plan that it will need to prioritize. However, in order to use its limited resources and funding most efficiently and effectively, the Lummi Nation will need to prioritize the areas of the Reservation that are most vulnerable to hazards and the projects that are most appropriate and effective in mitigating those hazards. In general, the following criteria will be used by the MHMT to prioritize mitigation actions and to seek potential funding for local organizations or projects:

- Projects that provide the greatest enhancement to public health and safety;
- Projects in which the benefits are maximized according to a benefit-cost review of proposed projects and their associated costs;
- Organizations with or projects that address the highest risks of hazard damage;
- Projects that involve repetitive loss properties; and
- Projects that address the most intense development pressures.

The MHMT will develop a ranking system that weights various factors and provides a relative score that reflects the importance of a project to the Lummi Nation and the residents of the Reservation. The MHMT will use these scores to rank proposed mitigation projects and to prioritize mitigation activities for action by the MHMT. The ranking system will include the following criteria:

- Reduction of threats to public health and safety;
- Reduction of potential structural damages;
- Reduction of potential economic losses;
- Effects on environmental and cultural resources;
- Degree of support for the MHMP goals and objectives; and
- The benefit/cost ratio of the project.

Since most hazard mitigation funding from federal and state sources requires a benefit/cost ratio greater than one, this ratio will be an important factor in the assessment of projects. Unless a project involves overriding public health and safety or cultural factors, the MHMT will only consider projects in which project benefits at least exceed project costs. In seeking to maximize public benefits, the MHMT will acquire the information and/or assistance necessary to determine the best possible benefit-cost ratio for high priority projects before submitting applications for these projects to funding agencies. Projects that are recommended for funding will be those that best document their ability to reduce future impacts of natural disasters as well as demonstrate cost-effectiveness through a benefit-cost review.

It is anticipated that projects addressing the multiple high vulnerabilities of the Sandy Point Peninsula, Floodplain, and Gooseberry Point areas will be top priority projects on the Reservation.

7. PLAN MAINTENANCE PROCESS

The federal hazard mitigation planning regulations (44 CFR 201.4) require state-level plans such as this MHMP to be reviewed, revised, and submitted for approval to the FEMA Regional Director every three years. The regulations require a plan maintenance process that includes an established method and schedule for monitoring, evaluating, and updating the plan; a system for monitoring implementation of mitigation measures and project closeouts; and a system for reviewing progress on achieving goals as well as specific activities and projects identified in the mitigation plan.

This MHMP is a living document that is intended to provide a guide for hazard mitigation to the Lummi Nation. The MHMP can be revised more frequently than three years if the conditions under which it was developed change significantly (e.g., a major disaster occurs or funding availability changes). This section details the Lummi Nation's method and schedule for monitoring, evaluating, and updating the MHMP and for monitoring the progress of mitigation actions.

7.1 RESPONSIBILITY FOR PLAN MAINTENANCE

The LIBC resolution adopting this plan (No. 2004-015; Appendix A) directs the pertinent LIBC department directors to form a MHMT by appointing appropriate representatives from their departments to be members of the MHMT. The core of the MHMT should include the LIBC Safety Officer as well as representatives from the Planning, Natural Resources, Law and Order, and Cultural Resource Management Program departments. Other LIBC divisions (e.g., Funding, Sewer and Water, Lummi Commercial Company, Housing, Communications, and others) may be represented as needed. This MHMT will be responsible for coordinating the implementation of mitigation measures and the maintenance of the plan. The MHMT will also be responsible for annual progress reports to be submitted to the LIBC and for the three-year update to be submitted to the LIBC and subsequently to FEMA for approval.

7.2 MONITORING, EVALUATING, AND UPDATING THE PLAN

The MHMT will review this MHMP annually and will update the MHMP every three years. Annual reviews will identify progress made on the implementation of mitigation measures and projects. Annual reviews will also assess the impacts of disasters in the Reservation region to determine whether the MHMP should be revised based on the new information. The annual review will occur during the last quarter of each calendar year to coincide with the tribal fiscal year and community reporting requirements. Assuming that FEMA will approve this MHMP during the first or second quarter of 2004, this timeline will ensure that the annual review every third year will occur during the period when the plan will be updated for re-approval by FEMA. Hazard mitigation progress and needs identified in the annual review will be described in an annual progress report for the LIBC and the General Council.

The effectiveness of projects and other actions will be evaluated at appropriate, project-specific intervals or, at a minimum, when the MHMP is updated every three years as

required for state-level plans submitted directly to FEMA. The process of updating the MHMP will include a review of hazard assessments, vulnerability assessments, potential losses, tribal capability, coordination with other planning efforts, funding sources, and recommended and potential new mitigation measures. In support of the three-year update, the MHMT will:

- Examine and revise the Hazard Risk Assessment (Section 4) as necessary to ensure that it describes the current understanding of hazard risks;
- Examine progress on and determine the effectiveness of the mitigation actions and projects recommended in this MHMP;
- Identify implementation problems (technical, political, legal, and financial) and develop recommendations to overcome them;
- Recommend ways to increase participation by LIBC departments and to improve coordination with other jurisdictions and agencies; and
- Review and, if desirable, revise the MHMP Action Plan.

The updated MHMP will be presented to the Lummi commissions identified in Section 2 (Planning Process) for approval and then to the LIBC for adoption before it is submitted to FEMA for re-approval.

7.3 MONITORING PROGRESS OF MITIGATION ACTIONS

Once established, the MHMT will meet on a regular basis, perhaps monthly, to ensure consistent progress on the implementation of mitigation actions. Representatives to the MHMT will report on the progress made by their respective departments. Departments not represented on the MHMT will be invited to meetings as needed to report on activities in their departments. The implementation of all short-term mitigation actions will be monitored by the MHMT on an ongoing basis until implementation is complete. Long-term actions being actively implemented will be monitored on an ongoing basis, or at least annually as needed. Long-term actions planned for the future will be reviewed during plan updates every three years.

The system for reviewing progress on achieving goals, objectives, and specific actions included in the mitigation strategy will be based on a checklist of all objectives and actions. This checklist will be reviewed annually by the MHMT. As described in the previous section, progress on mitigation actions will be described in an annual report to the LIBC and the General Council and in the three-year update of the MHMP.

In addition to the work products described in approved work plans for projects funded by the Pre-Disaster Mitigation Program, the Hazard Mitigation Grant Program, the Flood Mitigation Assistance Program, or other grant programs, quarterly or semi-annual (depending on reporting requirements of funding agencies) performance reports that identify accomplishments toward completing the work plan commitments, a discussion of the work performed for all work plan components, a discussion of any existing or potential problem areas that could affect project completion, budget status, and planned activities for the subsequent quarter will be submitted to the funding agency by the

assigned LIBC Project Officer. The agency-specific final grant closeout documents will also be prepared by the LIBC Project Officer at the conclusion of the performance period and submitted to the funding agency.

8. SUMMARY

The Lummi Reservation has significant exposure to ten natural hazards, and five of the six assessment areas on the Reservation have vulnerability to all ten hazards. The sixth assessment area, the Nooksack River Floodplain, is vulnerable to nine hazards (but safe from landslides). On a scale from low to high, the estimated vulnerability in the Reservation areas is moderate or above for up to eight of the hazards. Although the probability of occurrence for some of these hazards is low, the potential for damaging events, however rare, is real. With the combination of high vulnerability and high probability of both Nooksack River and coastal flooding, the flood hazard on the Reservation poses the largest natural hazard in terms of potential annual damages to structures, government services, and economic activity.

Some areas face a higher vulnerability to certain hazards. Structures in woodland areas have a greater risk of damage from wildfires, severe winter storms, and windstorms. Coastal areas generally have greater vulnerability to earthquakes, landslides, and windstorms relative to some other areas, as well as being vulnerable to coastal erosion, flooding, and tsunamis. With many areas of the Reservation vulnerable to multiple natural hazards, there is a cumulative effect on overall potential losses. For example, a single earthquake may damage the same structures in the coastal or Nooksack River floodplain areas via ground motion, liquefaction, and subsidence; by triggering landslides; and by generating a tsunami. A strong windstorm could damage individual structures with downed trees, with the multiple effects of a power outage, and with wind-generated waves and coastal flooding. Coastal erosion damages properties, increases the probability of landslides in bluff areas, and increases the probability of flooding in low-lying areas.

Where there is a cumulative effect on potential losses, there will also be a cumulative effect on the benefits derived from mitigation actions. For example, development regulations or property buyouts that keep or remove structures from hazard areas will avoid the damages associated with all of the hazards that uniquely affect the property. Likewise, the establishment of home emergency kits and improved emergency response capabilities will benefit residents during all hazard events. It is important to consider both cumulative impacts and cumulative benefits when assessing mitigation measures.

Achieving the objective of becoming a disaster-resistant Indian nation will require significant investment of funds that the Lummi Nation does not currently possess. Expensive measures necessary to reach this objective include relocation or acquisition and removal of many structures that are in highly vulnerable locations, construction of substantial flood protection structures, and possible seismic retrofitting of older structures (replacement of some structures may be more cost effective). Given the high cost of these projects, acquiring outside funds for these measures is a high priority action item. In addition to pre-disaster mitigation, recovery from disasters will also present a financial challenge to both the LIBC and individuals. Given the low median income for tribal members, the damages and economic disruption caused by a hazard event will be difficult to recover from without assistance.

Threats to public health and safety from natural hazards are also significant on the Reservation. Floods, earthquakes, winter storms, windstorms, wildfires, landslides, tsunamis, and volcanic activity all pose public health and safety hazards. Structural mitigation measures, especially those proposed in this MHMP, are important in addressing public safety hazards, and public education measures that improve preparation for and response to natural hazards may be equally important, or in many cases, more important than structural measures.

This MHMP represents a step toward disaster resistance. The Lummi Nation has already taken significant steps, including implementation of development and construction regulations (e.g., the Flood Damage Prevention and Building codes) and monitoring of hazard conditions. The mitigation actions and measures described in this plan offer the potential for significant progress toward reducing future natural hazard damages. Consistent attention and adequate funding to implement identified mitigation measures will be required to realize the potential for damage reduction.

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LIST OF ACRONYMS AND ABBREVIATIONS

Programs and Terms:	
BFE	Base Flood Elevation
CFHMP	Comprehensive Flood Hazard Management Plan
CFR	Code of Federal Regulations
CRS	Community Rating System
CWRMP	Comprehensive Water Resources Management Program
CZMP	Coastal Zone Management Plan
EAs	Environmental Assessments
EISs	Environmental Impact Statements
ER	Emergency Response (Policies)
FDPC	Flood Damage Prevention Code
FDRP	Flood Damage Reduction Plan
FHR	Flood Hazard Reduction (Project Policies)
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FP	Floodplain (Land Use Policies)
FTE	Full-Time Equivalent
GIS	Geographic Information System
HAZUS	Hazards – United States (FEMA software program)
LSR	Lummi Shore Road
LZC	Lummi Zoning Code
MHMP	Multi-Hazard Mitigation Plan
MHMT	Multi-Hazard Mitigation Team
MMI	Modified Mercalli Intensity
NEPA	National Environmental Policy Act
NERP	Nooksack Estuary Recovery Project
NFIP	National Flood Insurance Program
PDM	Pre-Disaster Mitigation
PGA	Peak Ground Acceleration
RCM	River Channel Maintenance (Policies)
SEPA	State Environmental Policy Act
SFHA	Special Flood Hazard Area
SWMP	Storm Water Management Program
TEPA	Tribal Environmental Policy Act
TRC	Technical Review Committee
UBC	Uniform Building Code
WM	Watershed Management (Policies)

Agencies and Organizations (Parent Organization):	
BIA	Bureau of Indian Affairs
Corps	U.S. Army Corps of Engineers
Ecology	Department of Ecology, Washington State
DEM	Division of Emergency Management
DOH	Department of Health, Washington State
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
GSC	Geological Survey of Canada
LIBC	Lummi Indian Business Council
LNR	Lummi Natural Resources Department
LWRD	Lummi Water Resources Division
NAST	National Assessment Synthesis Team
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service (USDA)
NWIC	Northwest Indian College
USDA	US Department of Agriculture
USDI	US Department of the Interior
USEPA/EPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service (USDI)
USGS	US Geological Survey (USDI)
WEMD	Washington State Emergency Management Division
WSDC	Washington State Department of Conservation

Appendix A:

LIBC Resolution No. 2004-015

“Adoption of the Lummi Nation Multi-Hazard Mitigation Plan”



LUMMI INDIAN BUSINESS COUNCIL

2616 KWINA ROAD • BELLINGHAM, WASHINGTON 98226 • (360) 384-1489

Natural Res.

RESOLUTION # 2004 - 015 OF THE LUMMI INDIAN BUSINESS COUNCIL

TITLE: Adoption of the Lummi Nation Multi-Hazard Mitigation Plan

WHEREAS, the Lummi Indian Business Council is the duly constituted governing body of the Lummi Indian Reservation by the authority of the Constitution and By-laws of the Lummi Nation of the Lummi Reservation, Washington; and

WHEREAS, the Council is responsible for protecting and ensuring the health, safety, and welfare of the Lummi People and the Lummi Reservation community; and

WHEREAS, the Council is responsible for the protection, restoration, enhancement, and management of the natural resources within the exterior boundaries of the Lummi Reservation and throughout the Lummi Nation's Usual and Accustomed (U&A) Fishing and Gathering Grounds and Stations; and

WHEREAS, natural hazard events have occurred in the past and larger events can be expected to occur in the future on and near the Lummi Reservation and within the Lummi Nation's U&A; and

WHEREAS, defined hazard management policies and a coordinated hazard plan will reduce the impacts of natural hazard events on the Lummi Reservation and within the Lummi Nation's U&A; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan identifies proposed actions for hazard preparedness and damage reduction, recommends priorities for natural hazard mitigation, and gains eligibility for future hazard mitigation programs; and

WHEREAS, implementation of the Lummi Nation Multi-Hazard Mitigation Plan will reduce natural hazard-related damages, reduce environmental impacts of hazard mitigation activities, and reduce the long-term costs of hazard mitigation; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan is consistent with the Lummi Flood Damage Prevention Code (Title 15A Lummi Nation Code of Laws), the Lummi Zoning Code (Title 15 Lummi Nation Code of Laws), the Lummi Building Code (Title 22 Lummi Nation Code of Laws), and the Water Resources Protection Code (Title 17 Lummi Nation Code of Laws); and

WHEREAS, the Lummi Fisheries and Natural Resources Commission (at their meeting on November 25, 2003), the Lummi Natural Resources Department Executive Director, the Lummi Planning Commission (at their meeting on December 18, 2003), and the Lummi Law and Justice Commission (at their meeting on January 15, 2004) recommend that the Lummi Indian Business Council adopt the Lummi Nation Multi-Hazard Mitigation Plan.

NOW THEREFORE BE IT RESOLVED, that the Lummi Indian Business Council adopts the Lummi Nation Multi-Hazard Mitigation Plan and directs the Directors of the Natural Resources and the Planning departments to designate appropriate staff members to implement the actions identified in the plan; and

BE IT FURTHER RESOLVED, that the Lummi Indian Business Council authorizes the formation of a Multi-Hazard Mitigation Team and directs the General Manager or his designee to coordinate the formation, staffing, and operations of this team and to ensure its effectiveness; and

BE IT FURTHER RESOLVED, that the Lummi Indian Business Council directs the Multi-Hazard Mitigation Team to report its activities semi-annually to the General Manager or his designee and annually to the Lummi Indian Business Council and General Council; and

BE IT FURTHER RESOLVED, that the Chairman (or Vice Chairman in his absence is hereby authorized and directed to execute this resolution and any documents connected therewith, and the Secretary (or the Recording Secretary in his absence) is authorized and directed to execute the following certification.

LUMMI INDIAN NATION

Darrell Hillaire
Darrell Hillaire, Chairman
Lummi Indian Business Council

CERTIFICATION

As Secretary of the Lummi Indian Business Council, I hereby certify that the above Resolution #2004-015 was adopted at a Regular Meeting of the Council held on the 19th of January 19, 2004, at which time a quorum of 7 was present by a vote of 6 For, 0 Against, and 0 Abstentions(s).

Sheri Williams
Sheri Williams, Secretary
Lummi Indian Business Council



Resolution 2004-015

Corrected version per 1/19/04 approved minutes

Appendix B:
Public PowerPoint Presentation
on the Lummi Nation Multi-Hazard Mitigation Plan

Draft Lummi Nation Multi-Hazard Mitigation Plan

Natural Resources Commission,
Planning Commission, Law and Justice
Commission, and Cultural Commission Briefing



December 2003

1

Purpose Statement

- ◆ The purpose of this presentation is to:
 - Describe the federal Pre-Disaster Mitigation (PDM) Program
 - Provide an overview of the Draft Multi-Hazard Mitigation Plan (MHMP)
 - Identify natural hazard vulnerabilities on the Lummi Reservation
 - Review past and current hazard mitigation
 - Identify the MHMP priorities and action plan

2

Presentation Outline

- ◆ Introduction
- ◆ Multi-Hazard Mitigation Plan (MHMP) Overview
- ◆ Estimated Hazard Vulnerabilities
- ◆ Past and Current Hazard Mitigation on the Reservation
- ◆ MHMP Hazard Mitigation Priorities
- ◆ MHMP Action Plan
- ◆ Summary

3

Pre-Disaster Mitigation Program

- ◆ The FEMA PDM program was authorized by the Federal Disaster Mitigation Act of 2000
- ◆ Provides funding for hazard mitigation plans and projects
- ◆ Lummi Nation received a 2002 PDM planning grant
- ◆ By adopting a hazard mitigation plan, the Lummi Nation is eligible to apply for state and federal grant programs to reduce potential damages from hazard events and repair future damages

4

Why a MHMP?

- ◆ Proposed actions are a proactive plan for increasing the health and safety of the Lummi people
- ◆ Reservation residents will benefit from defined hazard policies and a coordinated hazard plan
- ◆ Required for future mitigation funding eligibility
- ◆ Establish eligibility for the Lummi Nation as a direct grantee for hazard mitigation grant programs:
 - Pre-Disaster Mitigation Program project grants
 - Hazard Mitigation Grant Program (State EMD)
 - Flood Mitigation Assistance Program (FEMA)
 - Flood Control Assistance Account Program (Ecology)

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Purpose of the MHMP

- ◆ The purpose of the Multi-Hazard Mitigation Plan is to:
 - Assess natural hazard risks on the Lummi Reservation
 - Assess current mitigation capabilities of the Lummi Nation
 - Identify current and potential mitigation measures to increase public safety and reduce future damages on the Reservation
 - Identify mitigation priorities and an action plan

6

Draft Multi-Hazard Mitigation Plan (MHMP) Overview

7

MHMP Table of Contents

Executive Summary

1. Introduction
2. Planning Process
3. Description of the Lummi Reservation
4. Risk Assessment
 - Profiles of past events, vulnerability assessments, and estimated potential losses from large events
5. Mitigation Strategy
 - Goals and Objectives, Capability Assessment, Mitigation Measures, Mitigation Priorities, Funding Sources, and Action Plan
6. Local Planning Coordination
7. Plan Maintenance Process
8. Summary

8

MHMP Goals

- ◆ Reduce the threats to public safety posed by natural hazards
- ◆ Reduce the structural damages caused by natural hazards
- ◆ Reduce the environmental impacts of natural hazards, mitigation actions, and future development activities
- ◆ Reduce the long-term costs resulting from natural hazards and their mitigation

9

MHMP Objectives

- ◆ Prevent new development in areas that are vulnerable to hazards or ensure that development occurs in such a way that risk is minimized
- ◆ Protect or alter existing development in hazardous areas to make it less susceptible to damage
- ◆ Ensure that the solution chosen to protect existing development is the most cost-effective available; protects or enhances cultural resources, natural resources, and sensitive terrestrial, riparian, or coastal habitats; and is consistent with applicable land-use plans and regulations
- ◆ Ensure that the benefits of maintaining existing facilities outweigh their costs; if not, redesign projects to make them less susceptible to damage or implement some other type of solution at the site

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MHMP Objectives

- ◆ Redesign existing projects and/or change maintenance practices to protect or enhance riparian or coastal habitats
- ◆ Manage floodplains, rivers, streams, and other water resources for multiple uses, including flood- and erosion-hazard reduction, fish and wildlife habitat, fish harvesting, open space, recreation, water supply, cultural/traditional practices, and hydropower
- ◆ Improve coordination and consistency between the Lummi Nation and other jurisdictions, as appropriate, in management activities for floodplain and coastal areas
- ◆ Improve public awareness of natural hazards and appropriate preparation for and response to such hazards
- ◆ Improve hazard-warning and emergency response systems

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Natural Hazards Assessed in MHMP

- ◆ Floods
- ◆ Earthquakes
- ◆ Severe Winter Storms
- ◆ Windstorms
- ◆ Coastal Erosion
- ◆ Drought
- ◆ Wildfires
- ◆ Landslides
- ◆ Tsunamis
- ◆ Volcanoes

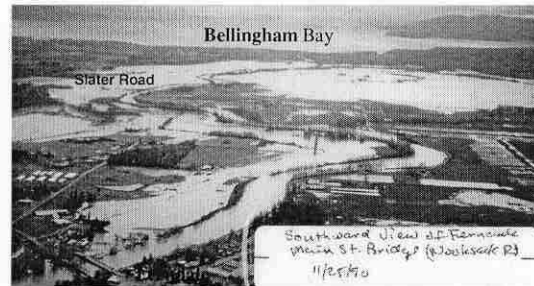
12

Assessment Areas on the Reservation



13

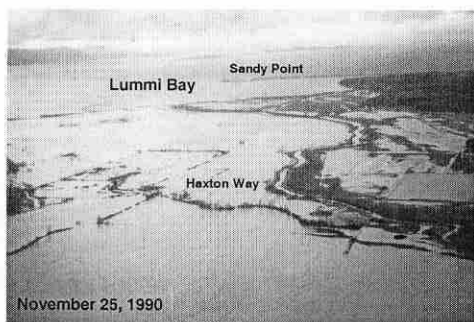
Nooksack River Flood History



November 25, 1990

14

Nooksack River Flood History



15

Coastal Flood History



♦ Lummi Shore Road, January 2, 2003

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Coastal Flood History



Gooseberry Point, January 2, 2003 (Haxton Way, looking south)

17

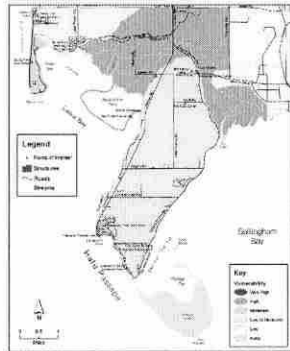
Coastal Flood History



Sandy Point Flood Damage
December 15, 2000

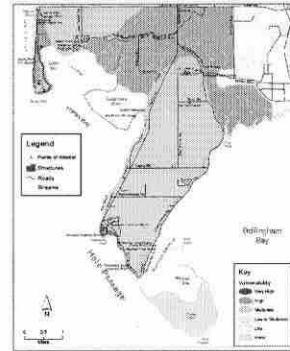
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Estimated Flood Vulnerability



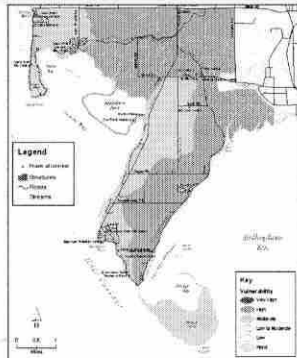
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Estimated Earthquake Vulnerability



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Severe Winter Storm Vulnerability



21

Estimated Windstorm Vulnerability

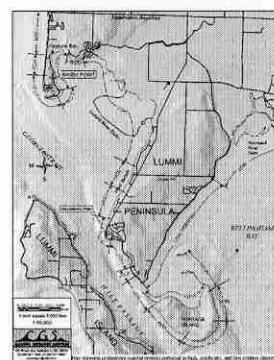


22

Coastal Erosion on the Reservation



Estimated Coastal Erosion Vulnerability



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Drought Vulnerability

- ◆ Drought effects:
 - Ground water shortage/saltwater intrusion
 - Reduced and degraded salmon habitat
 - Increased energy and food costs
 - Economic and job losses
 - Increased fire hazard
- ◆ Moderate vulnerability on the Reservation, but low-to-moderate probability of occurrence
 - Direct local effects reduced by maritime climate
 - Indirect effects of severe Eastern WA droughts can be large

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Estimated Wildfire Vulnerability



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Landslide History



- ◆ Coastal erosion in the past decade has caused landslides along West Beach (above), Lummi Shore Road, and Lummi View Drive

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Estimated Landslide Vulnerability



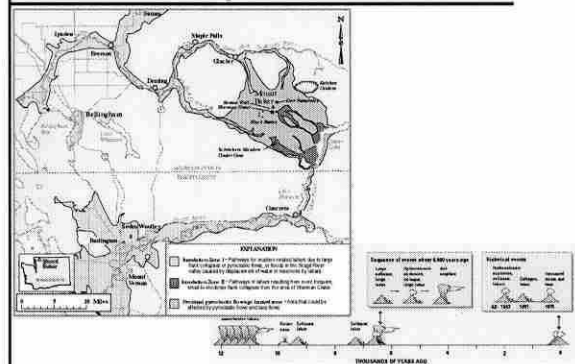
28

Estimated Tsunami Vulnerability

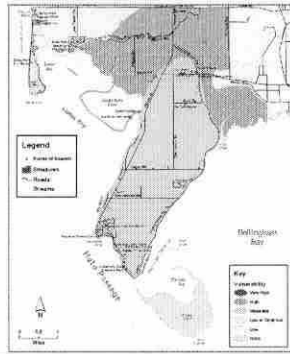


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Volcano History

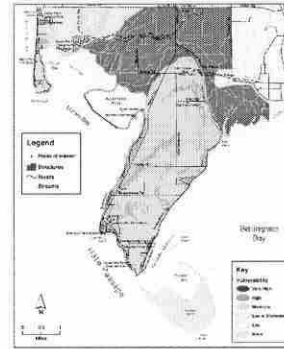


Estimated Volcano Vulnerability



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Combined Multi-Hazard Vulnerability



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Past and Current Hazard Mitigation

33

Lummi Flood Mitigation History

- ◆ Lummi Diking Project, 1926 - 1934: Lummi Bay seawall, Nooksack River levee, Lummi River levees
- ◆ Fuse plug in Lummi Bay seawall in 1975
- ◆ Floodplain homes raised after 1990 floods
- ◆ Tidegates in Lummi Bay seawall replaced and another fuse plug installed in 1998
- ◆ Lummi Title 15A Flood Damage Prevention Code, 1997
 - Established eligibility for National Flood Insurance Program (NFIP)

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Current Mitigation Measures

- ◆ Zoning Code
- ◆ Building Code (includes wind and earthquake design standards)
- ◆ Flood Damage Prevention Code
- ◆ Comprehensive Water Resources Management Program
- ◆ Comprehensive Plan
- ◆ Coastal Zone Management Plan
- ◆ Forest Management Plan
- ◆ Land-use permit review by the Technical Review Committee
- ◆ Emergency Management Response Interim Plan
- ◆ Spill Prevention and Response Plan (under development)
- ◆ Coordination with the Whatcom County Emergency Management Division, including participation on the Emergency Response Team

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MHMP Hazard Mitigation Priorities

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Mitigation Priorities for All Hazards

- ◆ Short Term:
 - Establish a Multi-Hazard Mitigation Team;
 - Promote the establishment and maintenance of home survival/emergency kits; and
 - Establish 24-hour emergency medical response capability located on the Reservation.
- ◆ Long Term:
 - Pursue funding for the Lummi Nation mitigation priorities and recommendations described in this MHMP, including funding for needed staff and infrastructure;
 - Improve and sustain public education programs aimed at mitigating natural hazards;
 - Redirect and/or relocate development away from hazard areas.

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Mitigation Priorities for Floods, Tsunamis, and Volcanic Hazards

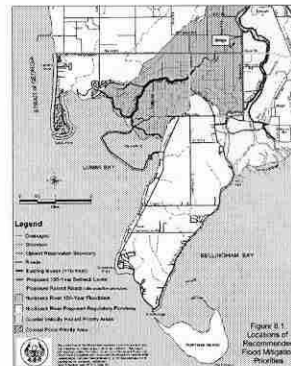
- ◆ Protect the Nooksack River floodplain on the Reservation and maintain access to the Lummi Peninsula by constructing a 100-year setback levee that extends along Ferndale Road from Ferndale to Kwina Slough, then along the north side of Kwina Slough to Marine Drive, and finally along Marine Drive to Lummi Shore Road (the levee should include a bridge over the Lummi River channel and culverts allowing flow under Marine Drive)
- ◆ Reduce the potential for flood damage along the low-lying coastal areas and concurrently reduce damage done to shoreline resources by bulkheads through the acquisition or relocation of flood-prone structures currently located in the coastal velocity zones

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Mitigation Priorities for Floods, Tsunamis, and Volcanic Hazards

- ◆ Raise Slater Road to the 100-year flood level both east and west of the Nooksack River and use bridges or causeways to allow floodwaters to pass downstream
- ◆ Protect, acquire, or relocate vulnerable structures in the coastal and riverine floodplains, outside of the velocity zone and floodway, respectively
- ◆ Provide access to the Lummi Peninsula in the case of levee failure by raising Haxton Way and providing for the flow of floodwaters under Haxton Way (this could serve as an interim measure prior to construction of a 100-year setback levee)

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Mitigation Priorities for Other Hazards

- ◆ Encourage seismic strength evaluations of critical facilities on the Reservation to identify vulnerabilities for mitigation of schools, public infrastructure, and critical facilities to meet current seismic standards
- ◆ Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices
- ◆ Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events

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Mitigation Priorities for Other Hazards

- ◆ Continue monitoring of erosion rates along the shorelines of the Reservation
- ◆ Limit construction in identified landslide areas and encourage construction and subdivision design that can be applied to sloped areas to reduce development effects on landslide vulnerability
- ◆ Install tsunami warning and evacuation route signs in hazard areas and provide residents in the hazard areas with updated information on the tsunami hazard, including the probability of occurrence, potential size of the hazard, signs of an impending tsunami, and best route to avoid a tsunami

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Recommended Action Plan of MHMP

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Recommended Action Plan

- ◆ Establish and maintain a Multi-Hazard Mitigation Team composed of representatives from pertinent LIBC departments and other organizations on the Reservation
- ◆ Pursue funding for the Lummi Nation mitigation priorities and recommendations described above, including funding for needed staff and infrastructure
- ◆ Approve a Comprehensive Plan that is aligned with the provisions of the Title 15A Flood Damage Prevention Code, the FDRP, the CZMP, other hazard-related ordinances, and the recommendations of this MHMP
- ◆ Coordinate hazard planning with other jurisdictions and review any actions proposed for the Nooksack watershed that may affect flooding on the Reservation (i.e., all proposed actions)

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Recommended Action Plan

- ◆ Review and possibly amend the Flood Damage Prevention Code in response to an analysis of future-conditions flood levels and flood management actions implemented throughout the Nooksack River watershed
- ◆ Review potential participation in the Community Rating System and, if desirable and practicable, take appropriate actions to earn points toward discounts of flood insurance premiums for residents of the Reservation
- ◆ Continue to review hazard maps for accuracy and any changes in the estimated vulnerability of the Reservation
- ◆ Coordinate LIBC emergency response efforts with those of Whatcom County and other jurisdictions/agencies
- ◆ Implement a public education effort that will inform residents of the potential hazards

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Summary

- ◆ The Lummi Reservation has significant exposure to ten natural hazards
- ◆ Large disasters will occur at some point in the future
- ◆ A coordinated hazard plan and a defined action plan will better protect Reservation residents
- ◆ By approving the MHMP, the LIBC will:
 - establish policies for reducing hazard damages
 - recommend priorities for reducing hazard damages
 - set a course of action
 - gain eligibility for future hazard mitigation grants
- ◆ Some recommendations will require further study
- ◆ Implementation will require adequate staff commitment and funding

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Recommended Action

- ◆ Pass a motion that recommends to the LIBC that they adopt a resolution approving the MHMP

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Appendix C:
Lummi Nation Emergency Management Response Interim Plan

THE LUMMI NATION EMERGENCY MANAGEMENT RESPONSE INTERIM PLAN

1) SECTION ONE – OVERVIEW

i) Purpose

The purpose of the Lummi Major Emergency Response (MER) Plan is to provide a structured planning, preparedness and response process from which Tribal Government and the Lummi Community may take appropriate steps to anticipate and prepare for a variety of disaster events that may occur within or impact the Lummi Nation and its reservation community. This plan and its implementation are essential to protect the lives, property and resources of the Lummi Nation. Due to the ultra-serious nature of major disaster events, the response to such incidents will be identified as a major emergency management response mobilization or MER Plan mobilization.

ii) Design

This plan is designed to address any significant emergency or disaster situation in which the Lummi Nation is required to mobilize a substantial and/or prolonged response independently within its own community or in coordination with other local, state and federal agencies. The Major Emergency Response Plan calls for a number of activities to take place to anticipate and prepare for major emergencies. The Plan requires that the Lummi Nation initiate:

- (a) Community-wide disaster plan development and preparedness
- (b) Assess identifiable threats and the risk they pose to the community
- (c) Assign response, coordination and decision-making roles and responsibilities
- (d) Coordinated responses with other local, state and federal response entities

iii) Scope

The Major Emergency Response Plan represents the policy of the Lummi Nation as it applies to preparing and responding to major emergency and disaster events within the jurisdiction of the Lummi Nation. The Plan shall be utilized to respond to natural and manmade emergency and disaster events that warrant an emergency response mobilization to protect and preserve the lives, health, environmental resources and property of the Lummi Nation or within its jurisdiction.

iv) Authority

Upon completion of the Major Emergency Response Plan, it will be presented by resolution by the Lummi Indian Business Council (LIBC) to be established as Tribal Government's official emergency response management plan for major emergency and disaster events and the policy of the Lummi Nation. At such time as this plan is formally adopted by the LIBC, all elected or appointed Tribal officials, division directors, department managers, unit supervisors and employees are responsible to respond to and comply with the guidance and direction provided by the Plan.

2) SECTION TWO – PLANNING AND PREPAREDNESS**i) Responsibilities**

In order for the Lummi Nation to be adequately prepared to face, respond to and manage a disaster event, government, business, families and individual community members must be prepared to respond. Advanced preparation will provide for a more coordinated and effective response in the face of most disasters that may occur within the jurisdiction of the Lummi Nation. The failure to adequately prepare for such events may render any subsequent response ineffective or less effective that it should and could have been. Inadequate, unprepared or uncoordinated responses may cause lives, property and resources to be endangered, lost or destroyed.

(a) Tribal Government

All elected and appointed Tribal Government officials shall be responsible for the preparation, readiness and response to identified emergency and disaster events in accordance with the elements of this plan. Additionally, officials, directors and managers shall be responsible for the development of such individual sub plans as may be necessary to direct unit responses to emergencies and disasters that may affect the operation of individual units of Tribal Government. Such sub plans shall be developed to be consistent with and complementary with this plan, and may include provisions for building evacuation, sheltering-in-place, emergency closure and disaster response.

(b) Governments or Disaster Response Entities

The Lummi Nation will, where possible and practical, work with other governments and disaster response entities in a cooperative manner so as to enhance the extra jurisdictional or regional response to disaster events that go beyond the border of the reservation or the jurisdiction of the Lummi Nation. To this end, the Lummi Nation will work and coordinate with appropriate local, state and federal disaster response and management agencies, especially the Whatcom County

Division of Emergency Management, wherever it is appropriate and reasonably possible to do so.

(c) Businesses and Organizations

All businesses and organizations within the jurisdiction and boundaries of the Lummi Reservation are responsible for preparing for and responding to disaster events. Wherever possible and practical, it is the desire of the Lummi Nation to work with such entities in a cooperative manner so as to enhance the community's response to disaster events. To this end, the Lummi Nation will make reasonable efforts to cooperate and work cooperatively with such entities in the event of a disaster event. However, the extent to which the Lummi Nation engages in such cooperative and/or supportive efforts shall be at the discretion of the Lummi Nation.

(d) Families and Individuals

The protection and survival of individuals and families is of primary interest of the Lummi Nation in every respect. To this end, individuals and families are encouraged to seek out disaster preparedness and response information from all appropriate sources. Tribal Government will prepare to provide such information to community members and to make the same available through its communications entities and directly from Tribal Government agencies and offices. Such information will be posted or links provided on Tribal Government websites. Information will be disseminated through Tribal Government publications and specific information will be made available in brochure form through Tribal Government offices, such as Housing, Planning and Police. In addition to acquiring disaster preparedness and response information, individuals and families are encouraged to take appropriate and reasonable action to prepare themselves and their families for the occurrence of disaster events as circumstances may indicate.

3) SECTION THREE – THREATS AND RISK ASSESSMENT

i) Potential Disaster Events

A variety of different types of disastrous events have the potential of creating circumstances necessitating a major emergency response mobilization, although the actual occurrence of such events is rare. However, it is vitally important that preparations for an appropriate response to disasters that do occur can be managed effectively to minimize loss of life and injury, damage to property, resources and public facilities, and disruption of normal activities. Such events may take the form of any of the following:

(a) Natural Disasters

Naturally occurring events such as floods, fires, earthquakes, tornadoes, volcanic eruptions and unusually severe storms and weather conditions all have the potential to pose serious threats to the health, safety and well-being of people, animals, facilities and resources. While some, like flooding, may be routinely predictable, other may only rarely occur without warning. All have the potential to cause serious injury, death, destruction and disruption.

(b) Manmade Disasters

Manmade or technological disasters occur on an irregular basis. All such occurrences have, at least, the potential to escalate to a serious level posing serious threats to the health, safety and well-being of people, animals, facilities and resources. Like natural disasters, such events are normally of limited duration, seriousness and impact as to render them manageable without a major emergency response mobilization. However, as with natural disasters, some unique events are of such a serious magnitude and level of threat, that they require a major mobilization and response of the Community's emergency resources for a prolonged period. It is at these times when the use of the Emergency Response Mobilization Plan is essential.

ii) Risk Assessment

A substantial number of potential threat sources may be found within the local environment that pose substantial threats and risks to the Lummi Nation and its community. Examples of potential threats, the levels of risk and potential for harm they pose are identified in the hazard tables below:

Natural Hazards

<u>Hazard Category</u>	<u>Level of Risk</u>	<u>Potential for Harm</u>
Flood	High	High – Damage likely
Earthquake	Moderate	Moderate – Damage likely
Mudflow/landslides	Moderate	Low – Damage unlikely
Severe Weather	High	High – Damage likely
Forest Fire	Moderate	Low – Damage unlikely
Tidal Overflow	High	High – Damage likely
Tsunami	Low	Low – Damage unlikely
Tornado	Low	Low – Damage unlikely
Volcanic Eruption	Low	Low – Damage unlikely
Epidemic	Low	Low – Damage unlikely

Manmade or Technological Hazards

<u>Hazard Category</u>	<u>Level of Risk</u>	<u>Potential for Harm</u>
Hazardous Materials	High	High – Damage likely
Fire/Explosion	High	Moderate – Damage likely
Transportation Accident	Mod/High	Mod/High – Damage likely
Utility Failure	High	Moderate - Some Damage
Resource Shortages	Low	Low – Damage not likely
Dam Failure	Low	Low – Damage unlikely
Radiological Accident	Low	Low – Damage unlikely
Civil Unrest	Low	Low – Damage unlikely
Terrorist Activity	Low	Low – Damage unlikely
War	Low	Low – Damage unlikely

4) SECTION FOUR – RESPONSE ACTIVATION THRESHOLDS

i) Classification of Events

During the normal course of community life, a variety of events will occur that warrant different levels of emergency response. Most events will be effectively and efficiently handled through normal means. Some emergency events will have the potential to become disasters and a few events will actually be disasters requiring a major emergency response mobilization.

(a) Normal Emergency Events

It is important to recognize that emergency events occur in communities across America that have harmful and even disastrous impacts on those involved in them. However, such events are not the focus of this plan. Such events are effectively addressed through the normal emergency response systems that are managed on a daily basis by community law enforcement, fire and rescue agencies. Most of the events noted in the threat and risk assessment sections above are managed in a highly effective manner by the normal community emergency response agencies, entities and resources. Such event will not normally result in major emergency response mobilization.

(b) Serious Emergency Events – (Escalation Possible)

On a less than frequent basis, emergency events may occur that are more serious than normal or daily emergency events. Such events may not be within the ability of initial responders to contain, control and resolve without exceptional actions or significant additional resources. Some may rise to the level of a disaster, although most will not. Those that do not rise to the level of a disaster will ultimately be handled with normally available resources. The few that do escalate to the level of a disaster will necessitate a major emergency response mobilization.

(c) Major Emergency and/or Disaster Events

Events will occasionally occur that are of such a magnitude and/or are so serious that they rise or occur above the ability of the normal emergency response resources to effectively contain, control and resolve them within a reasonable timeframe. Events that threaten the safety of a portion of or the whole community in a serious manner are generally considered to be potential or actual disasters warranting a major emergency response mobilization.

ii) Activation Thresholds

The decision to initiate a disaster response to an emergency event may occur at several levels. Once the decision to mobilize a disaster response to an event, a predictable series of events must then take place in order to ensure an appropriate response. For the purpose of this section, the response levels shall be as follows:

(a) Level One Event

- 1. Classification:** Routine Emergency Event.
- 2. Emergency Incident** – Emergency response units (police, fire, ambulance, hasmat) respond to an actual or reported emergency event for which such units have the training, equipment and time to handle effectively. Such situations are contained, do not have significant potential to escalate to a more serious situation and do not represent an uncontrolled threat to the Community.
- 3. Action** – The emergency event contained, managed and resolved through normal means by regular emergency response personnel and resources. No major emergency response mobilization is indicated or initiated.
- 4. Management** - The event is monitored by on scene personnel for a greater response if such is indicated. The event is managed to conclusion by on-scene or other available personnel and resources.

(b) Level Two Event

- 1. Classification:** Escalating Major Emergency Event
- 2. Escalating Emergency** – Emergency response units (police, fire, ambulance, hasmat) respond to an actual or reported emergency event for which such units have the training, equipment and time to handle effectively. However, the event is of such a nature that it may escalate or is escalating to a level

beyond which on-scene and/or immediately available back up units are able to control. Such events are serious and may or may not be initially contained or appear to be contained, but either escalate or are determined to be worse than initially believed. Such situations have the potential to threaten or do actually threaten portions of or the whole Community.

3. **Action** – Normal effort made to contain, manage and resolve the event through normal means by regular emergency response personnel and resources. If circumstances escalate or are determined to be more serious than initially believed, a major emergency response mobilization may be indicated. On-scene or command personnel overseeing event shall monitor the event and shall make recommendations regarding the initiation of a major emergency response mobilization as circumstances warrant.

- a. Notify Incident Command Executive Team of possible or actual Level Two Event.

4. **Management** - The situation is monitored by on-scene and command personnel in order to determine if a greater response is needed. At the point at which on-scene or command personnel determine that the event is reaching or is likely to reach a critical level beyond which available resources are able to control, contain and resolve the situation, the decision will be made to call in additional resources and whether a major emergency mobilization response is warranted. Critical escalation moves to a Level Three Event warranting MER Plan activation.

(c) Level Three Event

1. **Classification:** Actual or Declared Major Emergency Event.
2. **Disaster Event** – Emergency response units or other officials or persons become aware of an actual, imminent or reported disaster event. Such events clearly threaten the safety, health and well-being of the community or a significant portion of the community and warrant a major emergency response mobilization. Threats to the security of the homeland of the Reservation of the United States would also be included.
3. **Action** – Review of available information supports the belief that a major emergency response mobilization is indicated. Upon determination that the event warrants MER Plan activation, the appropriate person in authority initiates activation of the MER Plan by calling the Lummi Police Department and notifying the

dispatcher or police official of the decision to initiate a MER Plan activation.

- 4. Management** – Events that pose a clear and present danger to the Community or a significant portion of it will normally warrant a major emergency response. At the point when MER Plan activation is initiated, a full or phased response may be initiated depending on the circumstances. Managed to conclusion of initial, mitigation and recovery stages.

5) SECTION FIVE – MAJOR EMERGENCY RESPONSE

i) Activation of the Major Emergency Response Plan

(a) Activation Decision

The decision to activate the Major Emergency Response Plan (MER) Plan shall generally rests with the Chairman of the Lummi Indian Business Council (LIBC) or in the absence of the Chairman, an elected LIBC officer, or the General Manager, or in his absence, the Chief of Police, or his designee. The basis for such a decision is that an event has occurred or is clearly imminent that either requires or would be best handled through the implementation of the MER Plan. (See Section Four).

(b) All Necessary Action

Once the MER Plan has been implemented, the Emergency Operations Center (EOC) may be activated and the event managed under the Incident Command Authority of Tribal Government. The designated Incident Commander shall, in concert with the Incident Command Executive Team, shall take all necessary action to respond to, manage and bring to conclusion the major emergency event for which the emergency mobilization was initiated.

(c) Extended Action

Upon the conclusion of a major emergency event, the Incident Command Authority may initiate or recommend such immediate or continuing mitigation, recovery and follow-up action as may be deemed to be required.

ii) Emergency Response Priorities

To the greatest extent possible, all of the operations of the MER Plan will be directed toward the achievement of the priorities noted below:

1. Protect life

2. Protect public and private property
3. Provide an effective coordinated response
4. Provide critical emergency services
5. Restore essential services
6. Develop and disseminate public information
7. Minimize economic disruption to the community
8. Preserve existing tribal organizations and enterprises
9. Document and record decisions, costs, lessons learned, etc.
10. Insure feedback mechanisms are in place for the community

iii) Major Emergency Response Plan Activation Response

(a) MER Plan Notification - In the event of MER Plan activation, it is essential that key command staff and response and resource personnel be notified from the MER Telephone Callout list. Generally, it shall be the responsibility of the Tribal Police Department dispatcher, a specific designee, or the What-Comm Dispatch Center (if available) to initiate notification of the following:

1. The Chairman, General Manager and Chief of Police, or their respective designees shall be immediately notified.
2. Emergency Command Center Staff and support personnel shall be notified as need dictates.
3. All emergency response personnel contained on the Key Responder Notification List shall be notified as need dictates.
4. The Emergency 911 Dispatch Center will be notified.
5. The Director of Whatcom County's Emergency Management Division will be notified.

(b) Required Response - Upon notification or awareness of an actual or designated MER Plan level emergency or disaster, all designated command and support personnel shall, without delay, contact the Tribal EOC, by whatever means are available, to determine whether they are needed at the EOC or at another location.

1. **Non Availability** - If a primary senior Tribal official, department director, key responder or support person is either not available or not able to effectively respond to the EOC, the EOC Operations Officer shall be so notified, at which time he/she will

initiate contact with the next-in-line official to respond and assume the duties of the absent primary official.

- 2. Notification and Contact** – It shall be the responsibility of the senior ranking officer or support person on duty or on call to initiate notification and contact with Tribal Officials of an emergency event requiring a second or third level emergency or major emergency response.

iv) Command Structure

(a) Incident Command System

Once the decision to initiate the MER Plan has been made, all notification, coordination and responses will be directed by the Incident Commander, authorized command staff or field commanders, or the Emergency Operations Center (EOC), pursuant to the protocols established under the Incident Command System (ICS).

(b) Incident Command Executive Team

The Incident Command Executive (ICE) Team (normally the Chairman, General Manager and Chief of Police) shall be responsible to provide policy and administrative oversight, direction and decision-making necessary to effectively manage and respond to a declared MER Plan mobilization. Once notified or otherwise aware of a MER Plan activation, Executive Team members shall proceed to the Emergency Operations Center (EOC) of the Lummi Nation without delay in order to assume their assignment as part of the ICE Team. The ICE Team shall be responsible for overseeing the management of the emergency situation until it is concluded.

- 1. Chief Policy Officer** – The LIBC Chairman, or designee, shall assume the chairmanship of the Incident Command Executive Team to oversee the decision-making process of the Team.
- 2. Chief Administrative Officer** – The General Manager, or designee, shall participate in the Incident Command Executive Team's decision making process and ensure that compliance, availability and support of all Tribal Government personnel and resources in responding to and managing the emergency event. In the absence of the LIBC Chairman or his/her designee, the General Manager shall assume the chairmanship of the ICE Team.
- 3. Incident Commander** – The Chief of Police, or designee, shall oversee and coordinate the response of all emergency personnel and resources to the emergency Event.

- 4. Other Members or Advisors** – The Incident Command Executive Team Chairman may expand the Executive Team or include such advisors as may be deemed to be necessary and appropriate.
- 5. Incident Command Authority** – The Incident Command Executive Team shall represent the lawful authority of Lummi Tribal Government to oversee and determine its response to any major emergency event within the boundaries of the Lummi Reservation and is, therefore, the Incident Command Authority.

v) Emergency Operations Center (EOC)

Unless otherwise designated, the Lummi Police Department, located at 2616 Kwina Road, will serve as the EOC for the Tribal Community.

(a) EOC Operations

The EOC shall serve as the primary command center for the management of any MER level emergency or disaster from the initial response to its final conclusion. The EOC shall provide both general and specific direction to guide Tribal Government's response to a crisis incident. All communication for major decisions shall be directed to the EOC. Only those persons needed to provide services or support shall be permitted to enter or remain in the EOC. The Emergency Operations Officer shall be responsible for maintaining the security of the EOC.

(b) EOC Operational Roles and Responsibilities

The following duties and responsibilities shall be assigned within the EOC as circumstances warrant or as the Incident Command Executive Team or Incident Commander directs:

- 1. Information Officer** – The Information Officer is the person designated to act as the primary information and press liaison person responsible for gathering, organizing and disseminating information the public, press and other persons or entities making inquiries for information at the EOC during emergency events.
- 2. Safety Officer** – The Safety Officer is the person designated to be responsible for anticipating, noting and responding to safety considerations, both inside the EOC and for the emergency event.
- 3. Liaison Officer** - The Liaison Officer is the person designated to be responsible for engaging in liaison contacts and activities with other emergency operations centers or response entities,

such as Whatcom County, the State of Washington or the Federal Government during the emergency event. In the event of a multi-jurisdictional emergency event. The Liaison Officer may be dispatched to the Whatcom County EOC to represent the interests and needs of the Lummi Nation. In such a circumstance, the Liaison Officer would be able to provide timely communication and coordination between the Tribal EOC and the County or other EOC.

4. Operations Coordinator - The Operations Coordinator is the person designated to act as the primary coordinator and communicator with various personnel and resources. The Operations Coordinator would normally coordinate the following:

- i. Emergency Medical Services
- ii. Fire Services
- iii. Law Enforcement
- iv. Search and Rescue
- v. Public Works
- vi. Energy and Utility
- vii. Public Health and Mortuary

5. Planning Coordinator - The Planning Coordinator is the person designated to act as the primary coordinator of event documentation to enable the maintenance of an accurate record and timeline of events. This position shall be responsible to make note of issues that are important for follow-up review of the current event and planning for future events.

6. Logistics Coordinator – The Logistics Coordinator is the person designated to act as the primary coordinator and communicator with various personnel and resources associated with logistical needs during an emergency event. The Logistics Coordinator would normally coordinate the following:

- i. Resource management and supply
- ii. Transportation
- iii. Food and water
- iv. Mass care and shelter
- v. Volunteer and religious affairs
- vi. Emergency communications
- vii. Military support to civil authorities

7. Administration and Finance Coordinator - The Administration and Finance Coordinator is the person designated to act as the primary coordinator of event documentation. He/she shall also be responsible for the timely and responsive acquisition of the services, materials and resources needed to support emergency

response activities. This position is responsible to ensure that all appropriate contracting and purchasing requirements are properly addressed.

(c) Individual Command and Support Roles and Responsibilities

In the event of an MER Plan activation in response to a serious event or circumstance threatening all or part of the Lummi Community, various Tribal Government Officials shall be responsible to assume specific roles and responsibilities until such time as the threatening event or circumstances abate and the mobilization concluded.

- 1. Chairman** – Shall assume primary policy authority as the Chair of the Incident Command Executive (ICE) Team and have ultimate responsibility for overseeing the management of disaster or emergency event. In this role, the Chairman or designee shall be responsible to speak and act on behalf of the Lummi Nation and the LIBC. The Chairman shall have the authority and responsibility to ensure that all necessary Tribal resources are brought to bear on an emergency to preserve the Tribe, its members, its property and resources. The Chairman shall be responsible to make policy decisions regarding issues that are beyond the authority of the General Manager or the Chief of Police.
- 2. Vice Chairman** – Shall assume primary command authority and responsibility in the event of any MER Plan activation in the absence of the Chairman or upon delegation by the Chairman. The Vice Chairman shall oversee revisions to the Lummi Emergency Management Plan.
- 3. LIBC General Manager** - Shall assume duties as a member of the Incident Command Executive Team and assume primary command authority and responsibility in the event of any MER Plan activation in the absence of the Chairman or LIBC Officer, or upon delegation by the Chairman or Vice Chairman. The General Manager shall have the authority and responsibility to ensure that all of the operational resources of the Tribal Government are made available to respond to an emergency.
- 4. Chief of Police/Incident Commander** – The Lummi Police Chief shall assume the duties of a member of the Incident Command Executive Team and shall act as the Incident Commander of any emergency event that occurs within the jurisdictional boundaries and authority of the Lummi Nation. Such responsibility shall be so assigned unless otherwise relieved of such responsibility by Tribal Government's Command authority for specific cause and a replacement is

named to assume those duties. The Incident Commander shall direct general field operations of all emergency responder personnel or resources. In the absence of the Chief of Police, the Police Lieutenant, and subsequently the senior on duty sergeant, or other person designated by the Incident Command Executive Team, shall assume duties of the Incident Commander.

- 5. Emergency Operations Officer** – The Emergency Operations Officer EOO shall be a person designated by the Incident Commander (normally the Chief of Police) to act as the primary support and resource person responsible for the operation of the Emergency Operations Center. The EOO will make certain that the EOC is maintained before and during emergencies in an operational manner that enables it to provide for the efficient management of emergency events.
- 6. Team Support** - Once all of the members of the Incident Command Executive Team have arrived at the EOC, the EOC Operations Officer shall provide all due assistance and support to the Command team.

(d) Operations and Support Responsibilities

Division Directors and Department Managers and Supervisors - In order to make informed decisions and to ensure they are properly implemented, the department directors listed below will make themselves available to the Incident Command Authority or Team at the EOC, either in-person or via telephone and shall be prepared to provide current status reports as necessary and requested by the Incident Command Authority and/or the Emergency Operations Center, and to be ready to initiate such event-related activities as may be required. Directors that are to be available to the Incident Command Authority are as follows:

1. Planning Director
2. Life Center Director
3. School Superintendent
4. Housing Director
5. Information Services Director
6. Natural Resources Director
7. Tribal Attorney

- (e) Other Personnel** - Other directors, managers and supervisors and Tribal Government employees shall be prepared to make themselves available for assignment should the need arise throughout the duration of the MER Plan event. In the event that the Director is not available,

the person with delegation of authority for the Director shall make themselves available.

vi) General Operational Roles and Responsibilities

(a) Emergency Responders – Including police, fire, and ambulance services, at the direction of the Incident Command Authority, shall be responsible for responding to scenes of emergency incidents to:

1. Make primary assessments and report to their commands
2. Provide initial emergency services
3. Control the scene of a specific incident
4. Provide direction and control for search and rescue
5. Provide other services as directed by the Incident Command Authority

(b) Communications – At the direction of the Incident Command Authority will:

1. Provide for the development and release of press information
2. Provide liaison between EOC Command and the public and media
3. Provide for maintaining the LIBC Emergency Hotline
4. Provide other services as directed by the Incident Command Authority

(c) Emergency Operations Center Liaison – At the direction of the Incident Command Authority will:

1. Establish a liaison link with the Whatcom County EOC
2. Represent the needs of the Lummi Nation
3. Advise on the Lummi Nation's existing capacity to provide services
4. Coordinate County emergency response and recovery efforts
5. Provide other services as directed by the Incident Command Authority

(d) Public Works - At the direction of the Incident Command Authority will:

1. Assess the condition and availability of Tribal structures, facilities and roads
2. Coordinate use of heavy equipment and labor during response or recovery
3. Inspect and determine safety of all structures, facilities, homes and roads
4. Compile damage information and public facility needs

5. Provide for emergency repairs to Tribal rental homes, facilities and roads
6. Consider hazard mitigation in the development of policy and the design.
7. Provides technical information on damaged structures
8. Assist in debris removal from public structures, facilities and roads
9. Coordinate replacement of damaged or missing road signage
10. Assist in establishing and maintaining road closure and detour barricades
11. Assist in limited communication support (radio)
12. Provide other services as directed by the Incident Command Authority

(e) Transportation - At the direction of the Incident Command Authority will:

1. Make provisions for access and use of transportation facilities and vehicles
2. Assist in providing transportation assets to support emergency response
3. Assist private parties to gain access to transportation when possible
4. Provide other services as directed by the Incident Command Authority

(f) Housing - At the direction of the Incident Command Authority will:

1. Provide maps and address information
2. Coordinate emergency shelter for displaced persons
3. Assure healthy and safe HUD and rental structures
4. Maintain availability of emergency housing resources
5. Facilitate applications for FIMA eligibility and serves as liaison (FIMA)
6. Coordinate repair and rehabilitation of HUD and rental homes
7. Provide other services as directed by the Incident Command Authority

(g) Medical Support Services - At the direction of the Incident Command Authority will:

1. Provide medical triage at the scene or at removed triage location
2. Provide such medication care and treatment that may be indicated
3. Provide medical referral and treatment information as appropriate

4. Provide other services as directed by the Incident Command Authority

(h) Operational Support - At the direction of the Incident Command Authority will:

1. Provide needed facilities, vehicles or other resources
2. Assist in moving, preparation and set-up of evacuation shelters
3. Assist in set up and utilization of temporary morgue
4. Provide other services as directed by the Incident Command Authority

(i) Public Utilities - At the direction of the Incident Command Authority will:

1. Provide for safe drinking water
2. Ensure the containment and proper disposal of contaminated water
3. Coordinate the restoration of public water facilities
4. Assist with assessment, recovery and reactivation of:
 - i. Wells
 - ii. Hydrants
 - iii. Electricity
 - iv. Propane lines
 - v. Gas lines
 - vi. Underground fuel storage
5. Provide other services as directed by the Incident Command Authority

(j) Other Emergency, Auxiliary or Support Responders - At the direction of the Incident Command Authority will:

1. Provide such response, assistance and response as may be deemed necessary or desirable.
2. Observe and report event-related matters to the EOC.

6) SECTION SIX – EXTERNAL EMERGENCY RESPONSE COORDINATION

i) Plan Integration

The Lummi Nation will work with other external emergency entities and agencies to develop an integrated approach to responding to and managing disasters and major emergencies. To this end, the Chairman shall direct that plan integration efforts will be initiated, pursued and completed by the Lummi Nation with the following emergency response entities to the extent that it is deemed to be necessary, beneficial and appropriate:

(a) Whatcom County Division of Emergency Management (DEM)

(b) State of Washington

1. Via Whatcom County DEM
2. Directly where appropriate

(c) Federal Government

1. Via Whatcom County DEM
2. Directly where appropriate

(d) Local Municipalities and Industry

1. Via Whatcom County DEM
2. Directly where appropriate

ii) Cooperative Efforts and Support

The Lummi Nation shall engage in such cooperative emergency planning, response, mitigation and restoration with other jurisdictions and industry as it may be deemed to be necessary, beneficial and appropriate.

7) SECTION SEVEN – POLICY DEVELOPMENT AND ADDITIONAL ACTIVITIES**i) Duration of Interim Policy**

Upon formal adoption by the Lummi Indian Business Council, this Interim Major Emergency Response Policy shall remain in effect until it is replaced by a successor policy.

ii) Additional Support Documents to be Developed or Gathered

(a) The MER Plan Development Team will continue to facilitate the development of such additional documentation as may be deemed necessary to enhance the effectiveness of the Interim MER Plan.

1. A telephone listing and call out rosters of all key officials and response and resource agencies, businesses, organizations and people shall be developed and distributed as necessary.
2. Task Manuals (multiple copies) will be developed for each position within the Incident command operations structure of the EOC to provide specific details regarding the specific task assignments within the Incident Command Structure of the EOC.
3. A glossary of terms will be developed for inclusion in this and subsequent policies.

(b) Existing internal department and division policies existing or that may be developed subsequent to this policy shall be included within or referenced by this policy document.

(c) Identification Badges shall be researched and recommendations made to the General Manager for purchase of such official

identification as may be necessary to provide for the proper and timely identification of emergency responders and public officials.

iii) Final Version MER Plan Document to be Researched and Developed

- (a) The MER Plan Development Team shall continue to research and work to develop a MER Plan that is fully integrated with other similar plans and emergency response structures that exist at the local, state and federal level. Upon completion, the final MER Plan Policy shall be submitted to the LIBC for review and formal approval.
- (b) The Final Version of the MER Plan Policy shall include a section addressing the following areas:
 - 1. Search and Rescue Operations
 - 2. Homeland Security Operations

iv) Incident Command System (ICS) Training and Exercises

- (a) The Chief of Police shall be responsible to coordinate the search for and facilitation of Incident Command System Training for all appropriate tribal officials.
- (b) As soon as practicable, the Chief of Police will coordinate the development of a table top disaster drill with the Whatcom County Division of Emergency Management and other community emergency response entities.

Appendix D:
Lummi Nation
Title 15 Land Use, Development, and Zoning Code
and
Title 15A Flood Damage Prevention Code

TITLE 15
LUMMI NATION CODE OF LAWS
LAND USE, ZONING, AND DEVELOPMENT CODE

Enacted: Ordinance 1 (1/5/68)
 Ordinance L 39 (11/12/73)

Amended: Resolution U-44 (8/17/76)
 Resolution 79-62 (6/14/79)
 Resolution 93-62 (4/27/93)
 Resolution 2004-011 (1/19/04)

TITLE 15
LUMMI NATION CODE OF LAWS
LAND USE, ZONING, AND DEVELOPMENT CODE

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TITLE 15
LUMMI NATION CODE OF LAWS
LAND USE, ZONING, AND DEVELOPMENT CODE

Chapter 15.01 Purpose

15.01.010 Purpose

The use and development of the lands within the Lummi Indian Reservation directly affect the health, safety and general well being of its residents and the political and economic integrity of the Lummi Nation.

The Lummi Indian Business Council (LIBC) recognizes the need for implementation of a comprehensive zoning and development code to ensure orderly growth and protection of the political, economic, social, cultural, and physical integrity of the Tribe. This Title provides controls for land use, development, and zoning for all lands within the exterior boundaries of the Lummi Indian Reservation in order to: Promote the health, safety, and general well being of all residents of the Reservation and the political integrity of the Lummi Nation, and to promote harmony between the many interests on the Reservation; Promote consistency with the goals and policies of the Lummi Comprehensive Land Use Plan, provide clear development standards, establish a desirable pattern of land use, encourage functional and aesthetically compatible grouping of uses, and plan for the present and future use of land for living, commerce, industry, agriculture, resource extraction, and recreation; Ensure an adequate supply of land to support community facilities, roads, and utilities; Ensure proper management and preservation of natural resources, including forests, soils, tidelands, waters, and wildlife and ensuring the highest standards of environmental protection by promoting beneficial uses of land and natural resources; Minimize harmful effects of unmanaged development; Protect areas of archeological and cultural significance; and Ensure that no proposed development with the potential to cause significant impacts to the environment will be permitted before completion of a comprehensive review, in which alternatives to the project and mitigation measures have been considered.

15.01.020 Compliance with Building Code

Uses authorized by this Title or permits issued hereunder must also comply with Title 22 of this code (Building code.)

15.01.030 Owner's Permission Required

Each application for a land use permit, conditional use permit, temporary use permit, planned development permit, major or minor subdivision, variance, or zone change shall require written permission of the property owner for the proposed construction or land use activity. No land use or development activity shall occur without the owner's permission. For properties with multiple owners, the table in Appendix A indicates the portion of ownership interest necessary for each type of application.

15.01.040 Interpretation

The provisions of this Title are to be interpreted as minimum requirements for the promotion of public health, safety, convenience, order, morals, and general welfare.

Chapter 15.02 Duties and Functions of the Lummi Planning Department and Lummi Planning Commission

15.02.010 Duties and Functions of the Lummi Planning Department

The Lummi Planning Department, acting through the Director or his designee, is authorized to administer this Title, and to perform such duties and functions as are necessary to fulfill the purposes of this Title, including, but not limited to: provide application forms for permits along with any necessary directions and explanations; accept completed applications for processing; facilitate the review of permit applications by the Technical Review Committee; provide technical support for the Lummi Planning Commission in its rulemaking role; prepare and regularly update a Land Consolidation Plan, a Comprehensive Land Use Plan, and

the Official Zoning Map; prepare and submit a budget for completion of its functions under this Title in compliance with Title 28 of this code; investigate alleged violations of this Title and enforce the provisions of this Title; inform and educate the public about planning and zoning issues; establish a fee schedule for review and approval by the Lummi Planning Commission; prepare a map of the culturally sensitive overlay district for approval by the Lummi Sche'leng'en Commission and LIBC as a component of the Official Zoning Map; and prepare certifications for the Lummi Sewer District regarding applicants' status with respect to compliance with applicable tribal codes enumerated in 16.04.080.

15.02.020 Duties and Functions of the Lummi Planning Commission

The Lummi Planning Commission shall:

- (a) adopt pursuant to 15.02.030 such rules and regulations as are necessary for the efficient and effective administration of this Title;
- (b) hear any appeals filed pursuant to 15.13;
- (c) review the annual budget with the Planning Director;
- (d) approve proposed fee schedules, the Comprehensive Land Use Plan and any amendments thereto; and
- (e) review and recommend for approval to the LIBC the Official Zoning Map, including a culturally sensitive overlay district, a Land Consolidation Plan, amendments to such Map and Plan, and proposed amendments to this Title.

15.02.030 Promulgation of Regulations

Notice. Before final adoption of a regulation by the Lummi Planning Commission, the Director of the Planning Department shall post notice of the proposed regulation for public review and comment in at least three public places, inviting written comments and stating a deadline for their submission of not less than thirty (30) days after the posting of notice. The notice shall inform the public where copies of the proposed regulations may be obtained. The Director of the Planning

Department may, but is not obligated to, hold a public hearing; in that event, he will announce the time and place at which oral testimony will be heard.

Adoption. After the closure of public notice and comment period, or closure of the public hearing if one is held, the proposed regulations and all comments received shall be presented to the Commission for its review. The Commission may approve, amend, or disapprove of the proposed regulations, or the Commission may direct the Director of the Planning Department to prepare revisions to the proposed regulations and/or provide for further public review and comment.

Effective Date. A regulation will become effective upon its approval by resolution of the Lummi Planning Commission on the date specified in the resolution. If no date is specified, the effective date shall be the date the resolution is adopted by the Planning Commission.

Available for Inspection. A copy of all regulations will be filed and made available for public inspection at the Planning Department.

Emergency Regulations. If the Planning Director finds that immediate adoption of a regulation is necessary for the protection of the public health, safety, or welfare, and that complying with the notice and comment requirements of this Code would threaten the health or the public interest of the Lummi Nation, the Director may adopt immediately a regulation as an emergency regulation. An emergency regulation shall be effective upon the date of its adoption by the Director.

Notice of the emergency regulation may be posted in a public place, but such posting is solely to inform the public of its adoption, and nothing in this Code shall be construed to prevent the implementation of the emergency regulation upon its adoption by the Director in accordance with this section. An emergency regulation shall not remain in effect more than one hundred and eighty (180) days after its adoption.

15.02.040 Entry Upon Private Property

Members, employees and agents of the Lummi Planning Commission and Lummi Planning Department may enter property subject to this Title for purposes of inspections, surveys, and collecting information in the performance of their functions and duties under this Title. Such entries may occur upon any property, provided they do not unreasonably interfere with the use of the property by persons lawfully entitled to its possession.

15.02.050 Comprehensive Land Use Plan

The Lummi Planning Department shall prepare a comprehensive plan for the Reservation. The Comprehensive Land Use Plan shall be updated and presented to the Lummi Planning Commission for approval every five years, or more frequently, as needed.

15.02.060 Land Consolidation Plan

The Lummi Planning Department shall prepare a Land Consolidation Plan with the goal of consolidating tribal land holdings and reducing or eliminating undivided fractional interests in trust lands. The Land Consolidation Plan shall be presented to the Lummi Planning Commission for recommendation for approval to the LIBC and the Secretary of the Interior pursuant to 25 U.S.C. 2203.

15.02.070 Official Zoning Map

The Lummi Planning Commission and Lummi Indian Business Council have classified and divided the Reservation into zone districts. The boundaries for zone districts established in this code are shown on map(s) entitled the Official Lummi Nation Zoning Map and such mapping, along with all explanatory information, are by reference incorporated into and made a part of this code. The authorized copy of the zoning map shall be prepared by and kept in the Planning Department offices and shall be updated whenever zone district boundary changes occur.

Zone changes for areas of more than 40 acres shall be considered an amendment to the

Official Zoning Map and shall follow the procedure for Code amendments.

Chapter 15.03 Classification of Uses

15.03.010 Classification of Uses

A given land use may be one that is permitted, conditionally permitted, or disallowed—depending on the zone district and the nature of the project.

15.03.020 Permitted Uses

Permitted uses are allowed in a given zone district, subject to development, design and performance standards adopted and issued by the Lummi Planning Department.

15.03.030 Accessory Uses

Accessory uses are allowed land uses, subject to land use and building permit procedures, and, where applicable, conditional use approval. Common examples of accessory uses are garages, storage sheds, and outbuildings. Where permissible, an accessory use is:

- (a) Located on the same parcel as, and supporting or serving a primary use;
- (b) A developed area requiring less than 50% of the lot; and
- (c) Permitted with or supplemental to the primary use.

15.03.040 Conditional Uses

Conditional uses are allowed only after review and grant of a conditional use permit to ensure compatibility with permitted uses and existing development. Conditional use permit applications may be approved subject to performance, design and mitigation criteria. Review and application of limiting criteria are to ensure:

- (a) Comprehensive plan and zoning compliance;
- (b) Compatibility with development in the vicinity;
- (c) No hazardous or disturbing activities or impacts to public health and well being from

operation of the proposed use, or traffic generated by it;

(d) Adequate service of facilities and utilities; and

(e) No natural, environmental or cultural resources loss.

15.03.050 Temporary Uses

Temporary uses are specific activities and uses allowed for relatively short times at definite locations. The permit application and review procedure is the same as for conditional use permits, except that the application and the permit shall identify the time period during which the activity is permitted.

15.03.060 Non-conforming Uses

Non-conforming uses are those uses of land or structures and related activities legally established and existing on the effective date of this code which do not conform to one or more provisions or standards in the code, or are not permissible uses within the relevant zone district. Non-conforming uses may continue, subject to the following limitations. The intent of this section is to identify and retire non-conforming uses by regulating their existence and re-establishment.

(a) If the property used for a non-conforming use lies vacant, under construction, or the use otherwise ceases for a period of six months or longer, the use may not be re-established without conforming to this code.

(b) Expansion of non-conforming uses in the physical size or the intensity of use is not allowed unless all of the non-conforming provisions are corrected and approved by the planning department.

(c) If the property used for a non-conforming use or portion thereof is catastrophically destroyed, reconstruction for purposes of continuing the non-conforming use shall not be allowed beyond the foundation footprint and roof area of the original structure. Such reconstruction may only be allowed if the new structure and uses are found by the Planning Director to be a substantial improvement in

overall conformity to this code.

Voluntary or lawfully required destruction of non-conforming uses shall not be restored except in full conformity with all applicable codes. Repair, alteration, and rehabilitation of non-conforming uses shall be allowed with an approved conditional use permit and building permit. For properties that are non-conforming because they are smaller than the minimum lot size for the relevant zone district, lots of record shall be created, on the date of enactment of this code from contiguous parcels under common ownership, if at least one of them is substandard, to form the minimum lot size or dimensional requirements of the zone district.

15.03.070 Prohibited Uses

The following uses are prohibited in all zone districts unless specifically approved by the Lummi Indian Business Council:

(a) mining, except for sand and gravel extraction;

(b) sanitary landfills;

(c) adult-oriented businesses, including but not limited to retail, service or entertainment facilities that regularly offer live nude or topless entertainment or photographic or electronic depictions of sexual acts; and

(d) heavy industry.

Chapter 15.04 Zone Districts

15.04.010 Zone District Boundary Interpretation

Where uncertainty exists, zone district boundary interpretation shall be guided by these rules:

(a) Where district boundaries are shown along streets, roads, surface water channels, or parcel lines, the centerlines of these mapped features shall be considered the boundary location; or where the district boundary is shown to run parallel to a mapped feature, the offset distance shall be scaled and noted; or where the district boundary is a topographic variation, the ridge or the toe of the slope is considered the boundary location; except

where the district boundary is shown at the saltwater shoreline, it shall be defined according to Title 13, of the Lummi Code of Laws, to be located at the natural vegetation line separating the tidelands and the upland areas.

15.04.020 Residential Zone [R]

The residential zone district provides land for tracts of detached single-family homes with a density range comparable to both suburban and rural residential zones, depending on the type and level of services available and neighboring development. Development will be limited to rural densities, defined as 1-3 dwelling units per acre (DU/ac), where centralized infrastructure is not provided to the site. Suburban residential densities, at 5-7 DU/ac., are allowed when centralized water and sewer services are available to the site. With a planned development permit, land within the residential zone district may also be used for multi-unit residential development with densities of 9-12 DU/ac.

(a) Permitted Uses and Accessory Uses in Residential Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, permitted and accessory uses include single-family detached and duplex residences, attached or detached multi-family residential developments with fewer than 5 units, home occupations, outdoor and indoor storage, temporary residences, agriculture, and wood products growing operations.

(b) Conditional Uses in Residential Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, conditional uses in the residential zone include automotive repair and retail sales facilities related to home occupations, temporary and permanent business retail, office and service facilities, public and private community facilities, educational and government facilities, multi-family attached or detached developments with 5 or more dwelling units, detached second dwelling units, housing assignments made pursuant to the approved housing assignments policy, temporary residences, and small-scale agricultural and wood-products

harvesting operations.

15.04.030 Commercial Zone [C]

The commercial zone district comprises land suitable for commercial and business uses to meet objectives in economic development and provide employment opportunities to improve the economic conditions of Tribal members.

(a) Permitted and accessory uses in the Commercial Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, permitted and accessory uses in the commercial zone include agriculture-related businesses, automotive repair and service businesses, convenience stores, casinos, gas stations, financial institutions, retail food stores, medical offices and clinics, commercial auto and boat parking lots, commercial recreation facilities, restaurants, temporary and permanent retail stores, professional offices, public / government facilities, motels and hotels, and other retail, business, and service uses to be determined by the Planning Commission and designated by administrative rule.

(b) Conditional uses in the Commercial Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, conditional uses in the commercial zone include auto body, painting and wrecking facilities, warehouses, taverns and liquor stores, wholesale outlets, food processing facilities, fishing services, boat mechanical repair shops, outdoor heavy equipment storage, private and public community and education / research facilities, outdoor recreation, accessory residential use and home occupations, and temporary homes and events facilities.

15.04.040 Light Industrial [I]

The light industrial zone district provides land suitable for low impact industrial uses to meet objectives in economic development and provide employment opportunities to improve the economic conditions of the Tribe and its members.

(a) Permitted and accessory uses in the Light Industrial Zone Subject to design, development and performance standards

promulgated by the Lummi Planning Commission, permitted and accessory uses in the industrial zone include agriculture-related business, auto body, painting and wrecking facilities, warehouses, wholesale outlets, food processing facilities, manufacturing and assembly facilities, outdoor storage of heavy equipment, power generation, and wood products processing operations.

(b) Conditional uses in the Light Industrial Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, conditional uses in the commercial zone include farming, convenience stores, gas stations, restaurants, retail stores, offices, boat building, repair, and fishing service facilities, public and private community, education/ research facilities, accessory and temporary residences.

15.04.050 Forestry [F]

The forestry zone district allocates land suitable for the sustained cultivation and production of forest products and provides land for low-density rural residential development, where such mixed uses are consistent with the Comprehensive plan and Forest management plan.

(a) Permitted and accessory uses in the Forestry Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, permitted and accessory uses in the forestry zone include fish growing facilities, outdoor storage, single family and accessory residences, wildlife and game management, and wood products growing and harvesting.

(b) Conditional uses in the Forestry Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, conditional uses in the forestry zone district include farming and farm businesses, convenience and retail service stores, warehouses, temporary retail facilities, gravel mines, light industrial uses, outdoor heavy equipment storage, private and public community, recreation, and educational facilities, camping and picnic facilities, home occupations, multi-family residential use, temporary roads and sawmills,

and commercial logging.

(c) Forest Products Special Use District Within the Forestry zone district, land may be designated as within a forest products special use district, established to preserve valuable and productive forests and timber for sustained, highest yield and to plan development of them to harmoniously combine timber harvest with other land uses. The district includes forested tracts of sufficient size, determined to have well-managed, high-value timber and currently in active commercial forestry management. A land use permit is required for harvesting of forest products from this district, and a conditional use permit is required for any other use.

Criteria for forest products special use district are:

(1) classification by the Lummi Natural Resources Department as containing or being effectively managed for high-value commercial timber production.

(2) combination of legal parcels totaling at least 10 acres under forest management system(s).

15.04.060 Agriculture [A]

The agriculture zone district recognizes the importance of agriculture and allows the continuation of farming activities by allocating land for them. It also allocates land for accessory and supporting uses to farming, including residential and resource conservation. Uses like restoration and protection of natural resources and residential development are allowed in addition to farming

(a) Permitted and accessory uses in the Agriculture Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, permitted and accessory uses in the Agriculture zone include primary and accessory farming activities, large scale animal raising, agricultural business uses, accessory residential uses, and wood products growing.

(b) Conditional uses in the Agriculture Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, conditional uses in the agriculture zone include feedlots and manure processing, temporary agricultural retail outlets, gravel mining, fish and food processing facilities, outdoor storage of heavy equipment, home occupations, and resources management.

15.04.070 Open Spaces [OS]

The open space zone district provides land for preservation, conservation and restoration of environmentally and culturally sensitive areas and for low-impact, outdoor recreational uses.

(a) Permitted and accessory uses in the Open Space Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, permitted and accessory uses in the open space zone district include wildlife and natural resource management, parks and recreation facilities, culturally significant facilities, and wood products growing activities.

(b) Conditional uses in the Open Space Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, conditional uses in the open space zone district include public facilities, educational / research facilities, and wood products harvesting.

15.04.080 Marine [M]

The marine zone district comprises an area for treaty-reserved and tribally controlled fishing activities, seafood production, and harvest for the benefit of tribal members. All uses remain subject to tribal regulation of harvest and access pursuant to this code.

(a) Permitted and Accessory uses in the Marine Zone Subject to design, development and performance standards promulgated by the Lummi Planning Commission, permitted and accessory uses in the tribal fishing zone district include marine wildlife and game management, resource conservation and restoration activities, all types of subsistence seafood production, commercial fishing, and Tribal access of tidelands, off-shore and

inland waters for recreation.

15.04.090 Mixed Uses [Mx]

The mixed-use zone district is intended for important community centers where planned multiple uses are allowed and desirable. Any proposed use allowed in the immediately adjacent zone districts is allowed in the Mixed Use zone district with a conditional use permit.

15.04.100 Shoreline Management Overlay

Shoreline Management Overlay Districts extend inland 200 feet from the natural upland vegetation line on the ocean shore. Impacts to marine life, tidal and wave action, fishing, aqua-culture, Tribal ownership interests, natural shoreline characteristics, shoreline development and construction, and visual quality shall be mitigated before development within this overlay district will be permitted.

Land use development within the shoreline overlay is restricted, compared to the permitted uses in the underlying land use zone. Land use and development activities require a conditional use permit in the overlay area, including construction of bulkheads, seawalls, and any other shoreline alterations.

The Lummi Planning Commission is authorized to issue design, development and performance standards consistent with the Lummi Coastal Zone Management Plan to govern land use and development activities in this overlay district. The Lummi Coastal Zone Management Plan shall be prepared by the Lummi Natural Resources Department and reviewed periodically by that Department and updated as needed .

15.04.110 Water Resource Protection

Pursuant to Title 17 of this Code, activities in areas surrounding streams, wetlands, and potable water sources, and runoff into water sources are regulated to protect the Reservation's water resources. Permits issued under this Title shall comply with requirements of Title 17.

15.04.120 Culturally Sensitive Area Overlay District

The Culturally Sensitive Area Overlay District includes lands with a high probability of containing culturally sensitive sites. A map outlining the Culturally Sensitive Area Overlay District shall be prepared by the Lummi Planning Department, based on existing published information of cultural sites and historic uses. The map will not identify the location of any site specifically, but will instead define an area in which there is a high probability of finding sites of cultural significance. For proposed development or land use activities within the overlay district, an applicant will be required to conduct an appropriate cultural resources survey before an application is accepted as complete by the Lummi Planning Department. The Lummi Cultural Resources Management Program shall provide informational material for distribution by the Lummi Planning Department to applicants to inform applicants of any requirements for the performance of an appropriate cultural resources survey and the subsequent procedural requirements if a survey reveals the site is of cultural significance. The Lummi Cultural Resources Management Program shall participate in TRC review of all applications for proposed developments or land use activities in the Culturally Sensitive Overlay District.

Chapter 15.05 Permits Generally

15.05.010 Permit Requirements

With the exception of projects determined by the Lummi Planning Commission to be of such insignificant impact that no permit is required, a permit is required for all land use and development activities on the Reservation. The permit requirement applies to all persons and agencies proposing any land use activity or development, including the Lummi Nation or any Department thereof, and any owner or lessee of property on the Reservation.

15.05.020 Minor Projects Exempt by Rule

The Lummi Planning Commission shall adopt regulations to identify those types of small projects for which no permit is necessary.

15.05.030 Role of Lummi Planning Department

The Lummi Planning Department shall publish and make available to the public informational material sufficient to provide notice as to the need for permits for various land use and development activities, and to provide notice as to the type of permit necessary. For land use permits, conditional and temporary use permits, planned development permits, variances and zone changes, major and minor subdivisions, the Lummi Planning Department is authorized to produce application forms, accept applications for filing, reject applications for incompleteness, and facilitate review of applications by the Technical Review Committee.

Chapter 15.06 Permit Application and Public Notice Procedure

15.06.010 Applications

Applications for any land use permit, building permit, variance, temporary use or conditional use permit, planned development permit or zone change shall be made upon forms designed and provided by the Lummi Planning Department. Applications will not be accepted as complete and further processed until all required plans, drawings, maps, environmental and cultural checklists or other documentation and all required fees have been submitted to the Lummi Planning Department. Pre-application conferences with planning department staff are encouraged to provide an opportunity for applicants to ask questions and be fully informed as to any application requirements.

15.06.020 Environmental and Cultural Checklist Required

Each application for a land use permit, building permit, variance, temporary or conditional use permit, planned development permit, zone change, subdivision or variance must include an environmental and cultural checklist providing such information as the Lummi Planning Commission may by rule require, including the identification, description, context of the proposed project, and the potential environmental or cultural resource impacts posed by the project if

permitted.

15.06.030 Public Notice Procedures

(a) For land use permit, building code, variance, planned development, major or minor subdivisions, or conditional use permit applications submitted and accepted as complete, the Planning Department will, by the close of the next business day, post a public notice on the subject property. Posted notices shall be placed in prominent view from the primary road frontage on the right-of-way property line. The posting shall state the type of land use being proposed for the described property along with information and directions for persons wishing to inquire and/or formally support or oppose the proposal. The posting shall be in effect at least 15 days prior to permit issuance or public hearing.

(b) In addition to the posted notice procedure, the Planning Department will mail (first class) written notice to property owners of property located within 300 ft of the parcel boundaries of the property which is the subject of an application for a variance, conditional use permit, planned development permit, subdivision, or zone change. The mailing list shall be obtained from tribal and BIA records or the Whatcom County Assessor, and inaccurate or incomplete information so obtained shall not invalidate the public notice requirements of this section.

(c) A list of permits issued by type and date, shall be posted at the Lummi Planning Department and in the LIBC chambers lobby. The list of permits issued shall include the type of land use proposed, the date issued and the general location of the property.

15.06.040 Fee Schedule Authorized

The Planning Commission is authorized to adopt a fee schedule for permit applications, subdivisions, requests for variances and zone changes. The adopted fee schedule will provide incentive to submit permit applications and obtain permits or any other necessary administrative approval from the Lummi Planning Department before any land use or development activity is begun. Violations of this code may result in the

imposition of civil fines and penalties in addition to enhanced fees for permit applications and requests for administrative action made after any land use or development activity has begun.

Chapter 15.07 Review of Applications

15.07.010 Technical Review Committee Established

The Lummi Technical Review Committee (TRC) is hereby established to implement land use permit policies and procedures that facilitate judicious stewardship and informed decision-making relating to development of Reservation land and natural resources.

15.07.020 Purpose and Authority

The TRC is responsible for environmental review of all applications made under this Title. The TRC is authorized to make recommendations to the Lummi Planning Department following review of land use and development permit applications, and zone change and variance applications, balancing the current values and economic prosperity of the Tribe with the safety, health, and well-being of all residents. The TRC is authorized to recommend approval, denial, conditions of approval, and impact mitigation for any given application, and is responsible for timely review of applications and forwarding of its recommendations to the Planning Department.

15.07.030 TRC Review Criteria

The TRC shall review land use and development applications for compliance with Lummi Tribal Codes, protection of tribal resources and cultural values, and implementation of tribal policies. The TRC shall also review applications for compliance with Federal laws that can affect land use activities on the Reservation, including, but not limited to:

Archeological Resource Protection Act;
National Historic Preservation Act;
Federal Water Pollution Control Act (Clean Water Act);
Rivers and Harbors Act;
Resource Conservation and Recovery Act;
Safe Drinking Water Act;
Clean Air Act;
Endangered Species Act;

National Environmental Policy Act; and Coastal Zone Management Act;

The failure of the TRC, the Planning Department or the Planning Commission to identify a potential or actual violation of one or more of these codes or statutes does not exempt an applicant or owner from any duty to comply with these codes or statutes.

15.07.040 Composition of TRC

The TRC shall be composed of qualified technical staff representatives appointed by the Directors of the following departments and divisions:

- Planning Department, for land use development standards and zoning
- Realty Division, for land ownership, tenure, and real estate title issues
- Cultural Resources Department, for the protection of Tribal interests in cultural, historical resources
- Natural Resources Department, for the protection of land, air, water, and living resources
- Water and Sewer Districts, to verify service and supply
- Construction/Engineering Division, to establish civil engineering standards and provide advice on transportation (rights-of-way) issues
- Other Tribal departments, including LIBC, shall be included in the agenda distribution list and may participate in the review of projects of interest, at their discretion.

15.07.050 TRC Chair; Duties

The TRC chair is the current (permitting) planner and is responsible for setting and distributing the weekly agenda and for transmitting the recommendation of the TRC to the Planning Department.

15.07.060 Review Procedures and Schedules

Application review begins with a pre-application conference. A permit planner will, upon request of the applicant, conduct a pre-application conference, to discuss the project, determine its location, the site conditions and to inform the applicant of permit application requirements, including fees, and any additional documentation, maps, and

information necessary for the environmental checklist. Where relevant, the applicant will be informed of the need for verification of water and sewer service, cultural resources survey procedures, certification of ownership interest, design, development and performance standards, and the expected timetable for permit review and issuance of a decision.

15.07.070 Use of CEQ Regulations

With the exception of the regulations relating to public comment and responses, the federal regulations issued by the Council on Environmental Quality relating to the contents of environmental assessments and environmental impact statements (40 CFR part 1500 et seq., as amended from time to time) shall be used by the TRC and the Planning Department as guidelines for administering this Title, to the extent that the regulations do not conflict with any provision of this Title or any regulations adopted by the Planning Commission.

15.07.080 Review Process

(a) The TRC will review each application at a meeting not more than 10 business days following the application's acceptance as complete and posting of public notices. During this first review, the TRC will review the application and supporting information, any departmental or public comments and determine whether a tribal environmental assessment (TEA) is necessary to determine if significant environmental impacts will result from the proposed project or activity.

If the TRC determines that a TEA is required, the applicant must prepare and submit a TEA before the review process will continue. An applicant may choose to prepare and submit a draft TEA with the initial application.

(b) A TEA will be required unless the TRC finds: That the environmental impacts of the proposal have been adequately addressed in an earlier Tribal environmental assessment (TEA) or Tribal environmental impact statement (TEIS), in which case, the earlier document will be submitted as part of the application; or the proposed activity or project is included within a category of development excluded by Planning Commission rule from

the requirement to prepare a TEA. Such categorical exclusions may be identified by type of activity, location, or other relevant factor used in determining that no environmental review will be required.

(c) If a TEA is not required, the TRC shall issue its recommendation on the application to the Planning Director within 5 business days or shall issue a continuance of the process for not more than 15 business days. The TRC may recommend that the application be denied or issued, issued conditioned on limitations as to size, density, location, operating conditions, or any other mitigation requirements or conditions necessary to avoid significant impacts to the environment or violation of applicable laws.

(d) If a TEA is required, the applicant shall be notified, and the review process will be suspended until the TEA is received.

15.07.090 Once TEA is Filed

(a) Once the TEA is filed and determined to be complete, the Planning Department shall post notice of that fact pursuant to the public notice procedures in 15.06.030(a). The public notice shall provide for 15 business days for public comment. The TRC shall review the TEA and the application at a meeting no more than 15 business days following receipt of the TEA by the Planning Department. The TRC may require additional analyses, information or consultation to be included in the TEA, and will request in writing the additional information from the applicant.

Within 5 business days after the meeting at which an application and TEA have been reviewed, the TRC shall issue a recommended finding to the Planning Director: that the environmental assessment identifies potential significant impacts to the environment requiring the preparation of an environmental impact statement (EIS); or that the TEA will support a finding of no significant impact, and an EIS is not required.

(b) For applications not requiring an EIS, the TRC's report shall also include its recommendation on the application, including any recommended conditions or mitigation requirements if approval of the application is

recommended.

15.07.100 Further Review for Applications Requiring a TEIS

(a) The Planning Department shall notify the applicant in writing of the decision of the Department that an EIS is required. The applicant is responsible for preparation of the Tribal Environmental Impact Statement for the application. The Planning Department shall provide written guidance for applicants on the requirements for an adequate TEIS. The application review process shall be suspended until the applicant submits a draft tribal environmental impact statement.

(b) The applicant shall file a draft Tribal Environmental Impact Statement with the Planning Department, which shall post public notice of the availability of the Draft TEIS and the 15 business day comment period pursuant to the public notice procedures of 15.06.030 (a) and (b). Public comments shall be made available to the TRC, which shall review the application and the Draft TEIS at a meeting no more than 20 business days following the filing of the DEIS.

(c) The TRC may require additional information, analyses or consultation to be submitted by the applicant as part of the final TEIS. Final review of the application by the TRC shall occur at a meeting no later than 10 business days following the filing of the Final TEIS by the applicant. The TRC shall make its findings and recommendations on the application and forward them to the Director.

15.07.110 Decisions on Applications

The Director of the Planning Department shall issue decisions on applications for all land use permits, temporary use permits, building and occupancy permits, conditional use permits, planned development permits, subdivisions, variances, and zone changes.

Chapter 15.08 Conditional Use Permits

15.08.010 Criteria for Conditional Use Permits

Upon receipt of a conditional use permit application, and after TRC review and recommendations, the Planning Director shall

determine whether to deny a permit, or to issue a permit, allowing the proposed use with specific conditions. A conditional use permit may be issued only if the Director finds the use is conditionally permitted under the relevant zoning district; and the application and supporting documentation show the proposed use will: be in compliance with general policies and specific objectives of the Comprehensive Plan, the Tribal code, and will not be detrimental to the health, safety, and general well being of the community; be designed, constructed, maintained, and operated to be harmonious and appropriate to the existing or intended character of the surrounding area, and satisfying the purpose and intent of the zoning district; not be hazardous; and will not create detrimental nuisance impacts including noise, odor, smoke, fumes, light, glare, electrical interference, heat, or vibration beyond those permitted under Planning Commission regulations; be adequately serviced by public facilities and utilities, including streets, police and fire protection, stormwater drainage constructions, water and sewer connection, and other services; not create additional requirements at public cost for facilities and services, nor be detrimental to the economic well being of the Lummi Nation; be designed to avoid interference with, or excessive burden to traffic patterns in the surrounding neighborhood; and not result in detrimental impact to environmental or cultural resources.

15.08.020 Contents of Conditional Use Permit

Conditional use permits shall specify the location, nature, scope, and extent of the proposed use, together with the conditions imposed. Minimum requirements of this or any other title of this code or regulations shall not be waived or reduced by requirements of a conditional use permit.

15.08.030 Changes in Non-conforming Uses

Non-conforming uses may be allowed to expand or increase in intensity by a conditional use permit, consistent with the policies and limitations of 15.04.

15.08.040 Expiration of Conditional Use Permits

A conditional use permit shall expire twelve months after issuance unless construction, operation, or proposed activity has commenced or the original proponent has applied for and the Director of the Planning Department has granted a one-year extension of the permit.

15.08.050 Re-submission of Denied Conditional Use Applications

An application for a conditional use permit shall not be re-submitted unless the new application is deemed by the Director of the Planning Department to be sufficiently different to constitute a new proposal.

15.08.060 Non-transferable

A conditional use permit may not be transferred to a new owner or operator by lease, sale or otherwise.

Chapter 15.09 Variances

15.09.010 Purpose

The purpose of a variance is to provide a procedure by which a modification of the standards of this Title may be allowed. The variance must be in compliance with the general purpose and intent of this Title. Variances may not allow non-permitted uses or authorize a permitted use on a lot smaller than the minimum lot size for that use.

15.09.020 Criteria for Granting a Variance

Following review and recommendations by the TRC, the Planning Director may grant a variance if all of the following findings are supported by substantial evidence: Because of special adverse circumstances applicable to the subject property or its intended use, strict application of this code would create a substantial undue hardship and deprive the property owner of rights and privileges enjoyed by other property in the area under identical land use classification and regulation. The following conditions apply: Special adverse circumstances include irregular shape, unusual topography, difficult location, surroundings, or other atypical

physical characteristics. Desires of the applicant for particular aesthetic considerations or design preferences, without reference to physical characteristics, do not constitute sufficient undue hardship. The special adverse circumstances necessitating a variance are not the result of the applicant's action or failure to act. Granting the variance will not be detrimental to public health or welfare, or to other property and land uses in the area. The variance is not a grant of special privilege, nor shall a variance be granted for financial reasons alone. The property cannot be reasonably used under the existing zoning and development restrictions.

15.09.030 Expiration of an Authorized Variance

A variance shall expire after one year unless construction has been completed or a valid building permit, in conformance with the variance, is still in effect.

Chapter 15.10 Zone Changes

15.10.010 Zone Change Applications

Applications for zone changes affecting not less than 5 nor more than 40 acres may be initiated on an application form provided by the Lummi Planning Department by property owners with at least 75% cumulative interest in contiguous parcels of at least 5 acres nor more than 40 acres, not subject to probate proceedings. Zone change applications may be submitted with other permit applications for a specific project. Conditions of approval for a zone change application may include covenants and restrictions (C&R) to be recorded on the property's title.

15.10.020 Criteria for Approval of Zone Change Applications

After review and recommendation by the TRC, the Planning Director may grant a zone change if he makes the following findings supported by substantial evidence: The zone change would be consistent with the Comprehensive Plan. The application demonstrates a need for additional land to be allocated for use in the proposed zone: The application includes an explanation of how the proposed change will better serve the interests of the Lummi Nation.

A zone change shall not be approved if it would spot zone, defined as the arbitrary rezone of land incompatible with surrounding land uses; nor may a zone change substitute for a variance.

Chapter 15.11 Planned Development (PD)

15.11.010 Purpose

The planned development permit process is intended to provide mutual benefit to the general public and the applicant alike by allowing innovative and efficient land use and design, permitting greater flexibility in development requirements than is generally permitted, and requiring a higher standard for the provision of amenities. Planned development permits may be granted in any zone district except Open Space and are suitable for any residential, commercial or industrial project on property two acres or larger where the proposed use is a permitted, accessory, or conditional use allowed in the relevant zone district. The Lummi Planning Commission shall adopt design, development and performance standards for proposals for planned developments.

15.11.020 Criteria to Qualify as a Planned Development

To qualify as a planned development, an application must show how the proposed planned development attains all of the following criteria as compared to a proposal under any other permit type: Consistency with the goals, objectives, and policies of the Comprehensive Plan; Creation of less harmful effect on the values, health, safety, and general well being of adjacent property, area residents, and the users of nearby land; Make better use of the characteristics, features, resources, and amenities of the site; Result in lower demands for infrastructure and community services; Demonstrate fewer unmitigated impacts to the environment; Increase land use compatibility between the proposed development and surrounding property and uses; and Minimize adverse impacts to the natural environment and reasonably conserve natural topographic features

15.11.030 Density Allowance

A density allowance of up to 35% greater than the base density in the underlying zone district may be granted with award of a planned development permit.

Following review by the TRC, the Planning Director may grant or deny an application for a planned development permit.

Chapter 15.12 Subdivisions

15.12.010 Applicability

This chapter applies to partitions, lot line adjustments, minor subdivisions creating four or fewer lots, and major subdivisions creating five or more lots. A permit issued by the Lummi Planning Department is required for any of these activities. The Lummi Planning Commission shall promulgate rules governing the process for activities subject to this chapter and establishing standards for the granting of a subdivision permit. Application shall be made upon a form provided by the Lummi Planning Department. Following review by the TRC, the Planning Director may grant or deny an application for a subdivision.

Chapter 15.13 Prohibited Acts, Enforcement, Review, and Appeals

15.13.010 Prohibited Acts

It is civilly prohibited for any person to: forcibly, or by bribery, attempted bribery, threat, or other corrupt practice, obstruct or impede the administration of this Code; commit fraud, or knowingly assist another in the commission of fraud, with the intent to evade or defeat the lawful administration of this Code; falsify or make any material misrepresentation in any permit application or other document, or intentionally withhold information required to be submitted under this Code; violate the provisions of this Code, any regulations promulgated hereunder, the conditions or stipulations of permits issued hereunder, or any order of the Director of the Planning Department or of the Planning Commission issued hereunder; or engage knowingly in any act that obstructs or otherwise interferes with the performance by Lummi Nation employees of their lawful duties under this Code.

15.13.020 Judicial Enforcement

(a) Tribal Court Jurisdiction. Except as otherwise provided in this Code, the Lummi Nation Tribal Court shall have exclusive jurisdiction over all matters concerning the administration and enforcement of this Code; provided, however, that nothing in this Code is intended nor shall it be interpreted to preclude prosecution, or enforcement of Tribal Court judgments in state or federal court pursuant to any applicable state or federal law.

(b) Civil Enforcement and Remedies. The Director of the Planning Department is authorized to enforce the provisions of this Code by filing a civil action in the Tribal Court in the name of the Lummi Nation against any person engaged in an activity or activities prohibited by this Code or the regulations promulgated hereunder and may recover monetary damages, civil penalties, restitution, injunctive or declaratory relief, affirmative remedial action, court costs, investigatory and enforcement costs, attorney's fees, and/or any other relief that is just and equitable under the circumstances, including but not limited to orders for the person: to perform community service and to become informed about the need for compliance with this Code; to pay a civil penalty not exceeding Five Thousand Dollars (\$5,000) per day for each prohibited act for failing to comply with any order of the Director of the Planning Department, the Planning Commission, or the Tribal Court issued pursuant to this Code; to make restitution to the Lummi Nation and to affected persons for the cost of damages and restoration of property or other resource; or to pay the Lummi Nation any monetary benefit derived from the violation of this Code.

(c) Preliminary or Permanent Injunctions. Upon the filing of a motion for a preliminary or permanent injunction by the Director of the Planning Department or any other person designated by the LIBC, or upon its own initiative, the Tribal Court shall issue a preliminary or permanent injunction on the following grounds:

- (1) when an emergency restraining order

has been issued by the Director of the Planning Department under this Code, the Director of the Planning Department has moved for a preliminary or permanent injunction, and it appears by the pleadings or affidavits on file that the Director of the Planning Department is entitled to the relief requested; when it appears by the pleadings or affidavits on file that the commission or continuance of some act would produce great or irreparable injury to the public health, safety, or welfare or to the environment; when it appears that the person sought to be restrained is doing, threatening or is about to do, or is procuring or suffering to be done, some act in violation of this Code, a federal or Lummi Nation law, regulation, ordinance, order, or permit; or in all cases where an injunction would be proper in equity.

The Tribal Court's rules of civil procedure shall otherwise govern the procedures for issuing preliminary or permanent injunctions.

(d) Exclusion. For good and sufficient cause found, the Tribal Court may exclude from the Reservation any person who engages in an activity or activities prohibited by this Code or the regulations promulgated hereunder to the extent such exclusion is not inconsistent with applicable federal and Lummi Nation laws.

15.13.030 Non-Judicial Enforcement by the Director of the Planning Department

(a) Cease and Desist Orders. If the Director of the Planning Department or the Planning Commission has denied, revoked, or suspended a permit under this Code, the Director of the Planning Department may issue an order for the person whose permit has been denied, revoked or suspended to cease and desist his unauthorized activities. The order shall be in writing, describe the unauthorized activity, and advise the person of his right to appeal the Director of the Planning Department's decision denying, revoking, or suspending the permit as provided for in this Code and to show cause why the person should not be ordered to cease and desist from the activity. If the person continues the violation after the Director of the Planning Department issues a cease and desist order,

the Director of the Planning Department may issue an emergency restraining order and/or apply to the Tribal Court for a temporary restraining order or preliminary injunction.

(b) Emergency Restraining Orders.

(1) Upon receiving evidence that a person is engaging in any on-Reservation activity regulated by this Code and that the activity may endanger or cause damage to the public health, safety, or welfare, Lummi Nation water, or the environment, the Director of the Planning Department may issue an emergency restraining order and/or apply to the Tribal Court for a temporary restraining order or preliminary injunction. Every emergency restraining order or preliminary injunction order shall: be in writing, endorsed with the date and hour of issuance, and filed with the Planning Commission and Tribal Court within three (3) days of its issuance and entered on their records; define the injury; and expire within such time as is specified therein, not to exceed ten (10) days, unless within that time the Director of the Planning Department requests from the Tribal Court and is granted a preliminary or permanent injunction. For good cause shown, the Commission may extend the emergency restraining order until the Tribal Court rules on the Director of the Planning Department's request for a temporary or permanent injunction.

(2) On at least two (2) days' written notice to the Director of the Planning Department, the person whose activities are subject to the emergency restraining order may appeal the Director of the Planning Department's action to the Commission and seek the dissolution or modification of the emergency restraining order. In that event, the Commission shall hear the appeal in accordance with the procedures set forth in this Code and as expeditiously as the ends of justice require.

(c) Civil Fines. The system of civil fines for violations of this Code, the regulations promulgated hereunder, and the permits issued hereunder, may be established by Commission, subject to approval by the

Business Council; provided, that no fine shall exceed five thousand dollars (\$5,000.00) per day per violation; and provided further, that the imposition of a fine shall constitute a final decision by the Director of the Planning Department and be subject to the appeal procedures set forth in this Code.

15.13.040 Appeal to the Commission from a Final Decision of the Director of the Planning Department

(a) Notice of Appeal. An affected person aggrieved by a final decision of the Director of the Planning Department (“Appellant”) may file a written Notice of Appeal with the Commission, through the office of the Director of the Planning Department, within twenty (20) days of the person’s receipt of the Director of the Planning Department’s decision or within twenty (20) days of publication of the decision, if applicable. Such notice shall identify itself as a Notice of Appeal and state with particularity the basis of the Appellant’s claim that an action of the Director of the Planning Department is erroneous. The Appellant also shall file a copy of the Notice of Appeal with the Director of the Planning Department.

(b) Filing of Materials to Substantiate or Rebut Claim. The Appellant shall, within thirty (30) days from the date of receipt or publication of the Director of the Planning Department’s decision, file with the Commission, through the Office of the Director of the Planning Department, a brief addressing the Appellant’s points on appeal and any other materials, information, or evidence relevant to his, her, or its claim. A copy of the appeal materials shall be served on the Director of the Planning Department, who shall have twenty (20) days from service within which to file with the Commission a responsive brief and any materials, information, or evidence supporting his final decision. Appellant shall have ten (10) days from the receipt of the Director of the Planning Department’s brief and materials to file a reply.

(c) Hearing and Notice. Following the time period for submission of materials provided for in this Section, the Commission shall

schedule a hearing and give the Appellant and the Director of the Planning Department not less than five (5) days’ prior written notice of the hearing. Where more than one person files an appeal from the same final decision of the Director of the Planning Department, the Commission may conduct a single hearing on all appeals, provided that each individual Appellant has the right to appear and participate in full.

(d) Hearing Procedures. At the hearing, the Appellant will be afforded the opportunity to present testimony and evidence and to examine witnesses. Appellants may appear at the hearing for themselves or, at their own expense, be represented by an attorney, or other person authorized by Appellants. The Director of the Planning Department shall have the same rights to participate in the hearing as the Appellant. Hearings shall not be open to the public except upon the request of the Appellant and may be postponed or continued at the discretion of the Commission. All hearing testimony shall be given under oath. The Commission shall conduct the proceedings so that both complaints and defenses are amply and fairly presented. The Commission shall have the authority to administer oaths, issue subpoenas to compel the attendance and testimony of persons and the production of any books, records, and papers of the Appellant or any other affected person or party, and examine under oath, either orally or in writing, any Appellant or agent, or any other witness. The Commission may permit discovery, entertain and dispose of motions and require written expositions of the case as the circumstances justify. Formal rules of evidence shall not apply; the Commission may accept such evidence as it finds relevant and credible. The Commission may require reasonable substantiation of statements or records tendered, the accuracy or truth of which is in reasonable doubt. The hearing shall be on the record, and a permanent record of the hearing shall be made by tape recorder and/or stenographic means. The Commission shall, at the Appellant’s request and sole expense, make and preserve a complete written record of the proceedings.

Without undue delay, the Commission shall render a written decision in accordance with the law and evidence presented and shall

state the basis therefor. If the Commission finds that there was substantial compliance with procedural requirements and that the decision of the Director of the Planning Department was supported by substantial evidence in the record and justified by applicable policies, rules, laws, and regulations, it shall affirm the Director of the Planning Department's decision. If it finds to the contrary, the Commission may overturn the Director of the Planning Department's decision or any part thereof and/or remand the matter to the Director of the Planning Department with directions for further review. All decisions shall be signed by the Chairman of the Commission or other authorized Commission Member. A copy of the decision shall be mailed to the Appellant, certified mail, return receipt requested, and shall inform the Appellant of the right to appeal the decision to the Tribal Court and of the consequences of a failure to appeal. A copy of the decision also shall be served on the Director of the Planning Department.

15.13.050 Finality of Commission Actions

Any decision by the Commission on an appeal from a final decision of the Director of the Planning Department shall be final. If no appeal is timely made to the Lummi Tribal Court, such decision will be final, binding, and enforceable, and will not be subject to any further appeal to the Commission or to any court.

15.13.060 Appeals from the Commission's Decisions; Appeals to the Lummi Tribal Court; Exhaustion of Administrative Procedure

The Lummi Tribal Court shall have exclusive jurisdiction to hear all appeals from final decisions of the Commission. Except as otherwise provided for in the Code, the procedural rules of that court, as set forth in the Lummi Code of Laws and applicable court rules for the Tribal Court, shall apply. No final decision of the Director of the Planning Department may be appealed to the Lummi Tribal Court unless an appeal therefrom has first been timely taken to and decided by the Commission.

(a) Filing a Notice of Appeal to the Lummi Tribal Court. Within twenty (20) days after receipt of a final decision of the Commission, if the Appellant is dissatisfied with the decision of the Commission, he may file an appeal to the Lummi Tribal Court. The procedure for perfecting an appeal to the Tribal Court shall be as provided by the rules of that Court. The party appealing the decision must serve a copy of the Notice of Appeal on any other party and on the Commission. Service shall be made in accordance with the Lummi Nation's Rules of Civil Procedure governing service of process. The Lummi Nation may intervene in a proceeding for review, and, in its discretion, the Tribal Court may allow other affected parties to intervene in the proceedings. Thereafter, the Commission and Director of the Planning Department shall certify and transmit to the Clerk of the Court (a) the administrative record, including all documents, things, transcripts, and other information that formed the basis for the decision or ruling being appealed, or (b) such portions thereof as the Commission, Director of the Planning Department, and the parties may stipulate.

(b) Stay. The filing of a notice of appeal to the Lummi Tribal Court shall not operate as a stay of enforcement of the Commission's decision, but the Tribal Court may order a stay upon such terms as it considers proper.

(c) De Novo Review Not Permitted. The Tribal Court shall consider the appeal only upon the same theories and evidence as were asserted before the Commission. All such appeals shall be upon the administrative record presented to the Commission and shall not be de novo except as otherwise provided in this Section. The Court shall give due weight to the experience, technical competence, and specialized knowledge of the Director of the Planning Department, as well as the discretionary authority conferred upon the Director of the Planning Department.

(d) Leave to Present Additional Evidence. If application is made to the Court for leave to present additional evidence, and if it is shown to the satisfaction of the Court that the additional evidence is material to the issues in

the case, and that there were extraordinary circumstances and good reason for a party's failure to present it in an earlier proceeding, the Court may order that such additional evidence be presented to the Commission upon such conditions as the Court deems proper. The Commission may modify its findings and decision by reason of such additional evidence and shall file with the reviewing court, to become part of the record, the additional evidence, together with any modified or new findings or decision.

(e) Standard of Review. Upon appeal to the Lummi Tribal Court, the Court shall set aside a decision of the Commission only if it finds the decision to be: arbitrary, capricious, or an abuse of discretion; not supported by substantial evidence in the record; or otherwise not in accordance with applicable law.

(f) Decisions of the Lummi Tribal Court. The Tribal Court shall issue a written decision on all appeals, which decision shall be final, unless a timely appeal is filed with the Lummi Tribal Court of Appeals. Appeals to the Tribal Court of Appeals shall be filed and served according to the civil rules for appeals in the Lummi Code of Laws and applicable court rules. The decision of the Lummi Tribal Court shall not be stayed pending an appeal to the Tribal Court of Appeals unless a request for stay is made to and approved by the Tribal Court of Appeals according to the civil rules for a stay and upon such terms as the Court of Appeals deems proper. The decision of the Tribal Court of Appeals on the merits of the appeal shall be final, binding, and enforceable.

15.13.070 Limited Waiver of Sovereign Immunity

The LIBC hereby waives its sovereign immunity from suit and that of the Director of the Planning Department and the Commission for the express and sole purpose of allowing review by the Commission of the Director of the Planning Department's actions and of allowing review by the Lummi Tribal Court and the Tribal Court of Appeals of the Commission's actions under this Code; provided that any such appeal must be timely and properly filed; and provided further, that

such waiver is made only to the extent necessary to subject the Director of the Planning Department, and the Commission to suit for the sole purpose of declaring and adjudging rights and obligations under this Code and the regulations promulgated hereunder and does not waive immunity with respect to suits for monetary damages. This waiver is strictly limited and specifically does not waive the sovereign immunity from suit of the LIBC, nor does it waive the immunity from suit of the Lummi Nation, or any officer, employee or agent thereof for any purpose other than those enumerated in this section.

Chapter 15.14 General Provisions

15.14.010 Effective Date

This title shall take effect thirty days after the date of its enactment by LIBC Resolution.

15.14.020 Severability

If any section, clause, or provision of this code, or its application to any person or circumstance, is declared invalid for any reason by a court of competent jurisdiction, the remaining provisions of the code or application to any other person or circumstance shall still be valid and in effect.

15.14.030 Repeal of Existing Tribal Land Use Codes

Title 15 of the Lummi Nation Code of Laws in effect at the time of the effective date of this Title, is repealed, except Title 15A, which remains in effect.

Chapter 15.15 Definitions

15.15.010 Generally

The following rules of interpretation and construction shall apply throughout Title 15: Words used in the present tense include the future and vice versa; Words in the singular number include a plural condition and vice versa; "Shall" is mandatory and not discretionary; "May" is permissive and discretionary; and gender references are interchangeable.

15.15.020 Definitions

As used in this title:

“Accessory use” means a subordinate land use supporting a primary permitted use located on the same parcel.

“Acre” means a unit of measurement for land area equal to 43,560 square feet (originally measured 165 feet X 264 feet).

“Addition” means any construction or development increasing the size of a building or facility in area, size, mass, or gross floor area.

“Adult Business” means a land use involving the sales, distribution, or display of goods, services, or any other activities that involve any exhibit, reference, or allusion to sexual, pornographic, or other adult themes, whether for profit or free. The definition includes sales or rental of audio or visual media and massage establishments, excepting the uses listed below, and includes all uses providing live adult entertainment, tattooing or body alterations, and any other activities where nudity, anatomically explicit demonstrations or sex-related activities occur. “Adult” means those persons 18 years of age or older. Exceptions include uses providing professional, licensed massage therapy; or providing medically approved services; or commercial retail land uses that limit the stock and trade of adult print and video media or adult-oriented goods to less than five (5) square feet of sales floor area, or less than 5% of total sales floor area, whichever is smaller, provided that this portion of the sales area is not generally accessible to the public, and further provided that if the merchandise on display in this area depicts any nudity or sex-related activities, the merchandise shall be screened in such a manner as to prevent its viewing by the general public.

“Agricultural business” means a primary commercial use serving the needs of area farmers.

“Applicant” means the person or entity requesting, on forms provided by the Planning Department, approval of a lease, permit, license, certificate, or other entitlement for land use.

“Application” means the form and information submitted by an applicant, used to determine either approval or denial of permits or other entitlement for use.

“Approval” means the issuance of a lease, permit, license, certificate or other entitlement for an application accepted as complete.

“Aquaculture” means the farming, handling, harvesting, or culture of food fish, shellfish, or other aquatic plants or animals in fresh or saltwater, and includes development of hatcheries, rearing pens, shellfish rafts, and natural rearing and spawning areas.

“Building” means any structure used or intended for supporting, sheltering, or enclosing any use or occupancy, except mobile homes are not included.

“Campground” means a commercial land use providing temporary transient lodging accommodations for recreational users.

“Commission” means the Planning Commission of the Lummi Nation.

“Community facility” means a public facility owned and used by the Lummi Nation for the general purposes of the Tribe.

“Comprehensive Land Use Plan” means an integrated policy planning document designed to guide land use development decisions, based on consideration of land use alternatives, likely impacts, and potential mitigation. It defines the overall goals and objectives of land use and development in a series of policy statements, reflecting community values.

“Conditional use” means a use not permitted outright by this Title, and permitted only after public review and approval by the Department, and to which special conditions of approval may be attached.

“Cultural Resource” in the traditional view of the Lummi includes, but is not limited to, four major category types: language, including traditional named places and oral history or tradition; traditional cultural properties; historic sites; and archaeological resources.

“Cultural Resources Management Program” means the Lummi Nation Cultural Resource Management Program which consists of three components that perform the following functions:

- 1) Sche’lang’en Department (Cultural Identity);
- 2) Historic Preservation Office (Regulatory Compliance); and
- 3) Cultural Contract Services Department (Archaeology Consultants).

“Design” means the location, size, alignment, configuration, grade, and the construction details of: roadways, streets, easements, and rights-of-way, utilities and drainage facilities, and other specifics of the proposed development plan necessary to ensure conformity of the Comprehensive Plan and this Title.

“Detached housing” means a single-family dwelling unit not attached to any other structure.

“Department” means the Lummi Nation Planning Department.

“Development” means any activity requiring Federal and/or Tribal approval for use, alteration, or activity on land or land resources.

“Director” means the Director of the Lummi Nation Planning Department.

“Duplex residence” means a detached building containing two single-family dwelling units.

“Dwelling unit” means a structure or part of a structure or modular manufactured housing, constructed or installed on a permanent foundation, and used by one family for human habitation, including facilities for cooking, eating, sleeping, toilet and bathing. Does not include tents, recreational vehicles, or travel trailers.

“Environmental assessment (TEA)” means a preliminary environmental analysis used to determine whether a proposed action will result in significant environmental impact, requiring a more detailed TEIS.

“Environmental impact statement (TEIS)” means a public document used to analyze and report on the probable significant impacts and effects of development on the surrounding area, to identify alternatives, and to disclose possible ways to reduce or avoid environmental damage.

“Feed lot” means a confined space used as part of an intensive animal or poultry feeding operation, using outdoor or indoor enclosures to feed forage products not grown or stored in the confined space to animals.

“Finding of non-significant impacts (FONSI)” means a determination that the impacts to the environment, identified in an environmental assessment of a particular development project, are insignificant.

“Fishery” means the collection of all fish and shellfish commonly originating or harvested either commercially or for sport from Puget Sound and its freshwater tributaries, together with the habitat in which they thrive.

“Fish hatchery” means a complex of constructed ponds, basins, channels, weirs, water treatment and delivery systems, laboratories, and accessory uses designed to raise fish from spawning to release or sale.

“Food processing” means an industrial land use to cultivate, harvest, sort, store, wash, trim, package, or ship food products for sale.

“Foundation” means a construction made of masonry, concrete, treated wood, or other material, supporting the structure of a building on the ground surface and conforming to the requirements of the uniform Building Code and Development Code of the Lummi Nation.

“Gravel mine” means a land use providing mineral construction materials important to the Lummi Nation.

“Groundwater” means the water existing beneath the earth’s surface, including that beneath streams and surface water features of the effective area.

“Home occupation” means a small,

commercial or service business operating on the same residential parcel where the operator lives. Synonymous with Cottage industry, home occupations are permitted so long as the scale and intensity of activity is compatible with the surrounding uses and the off-site impacts of the use are comparable to those generated by residential uses.

“Industrial” means a use providing land for development of a broad range of business activities characterized by massive and intensive capitalization of resources and conduct of operations to produce or transform materials for sale. Industrial land uses are categorized by the degree of adverse impact to the natural and socio-economic environment or by creation of hazardous or commonly recognized offensive conditions. “Light industrial” includes component manufacturing, transformation, and assembly land uses, with few to no permanent unmitigated impacts to the natural environment and using light-impact processes and materials. Light industry operations provide socio-economic impacts that are easily absorbed and dealt with by the community. “Heavy industrial” means a primary manufacturing and production land use with unavoidable adverse impacts to the environment and the socio-economic fabric of the region. Despite compliance with performance standards, heavy industries may pollute the air, ground and water; may produce hazardous or nuisance conditions; or may significantly affect the transportation system, infrastructure, and the general social or economic well-being of the community.

“Legal description” means a method of geographically identifying a parcel, acceptable in courts of law.

“Lot” means any parcel of real property approved by a record of survey, plat, parcel map, or subdivision.

“Lot line” means the line bounding and defining the dimensions and area of a real property division. The front lot line parallels the roadway serving the lot. Also called the parcel line.

“Lot line adjustment” means a minor shift of

an existing lot line. It is not a subdivision of property.

“Marina” means a facility providing wet moorage and/or dry storage for pleasure and commercial fishing boats and related equipment, commercial businesses selling boating-related products and services, and/or launching facilities and covered moorage. Marinas may be public or restricted to private use. Marine moorage, outdoor boat storage, and marine retail land uses are included.

“Medical service” means a land use providing public health care including consultation, diagnosis, lab analyses, therapy, and treatment by doctors and dentists; and facilities, including clinics, treatment centers, hospitals, and other facilities for healing.

“Minimum” lot size” means the smallest allowable portion of a parcel determined to be usable for the proposed construction of facilities, according to applicable development standards.

“Mitigation” means the process deemed necessary to lessen potential identified impacts of land use development and/or proposed actions on the environment.

“Motel / hotel” means a commercial land use providing temporary lodging facilities for rent by visitors on a temporary basis, including individual sleeping, bathroom, and parking; and may include cooking facilities. The term includes attached or detached facilities, but not campgrounds.

“Multi-family dwelling” means a single building containing two or more attached residential units.

“Nuisance” means a use of property that interferes with the use of other property and rights of other property owners by causing damage, annoyance, or inconvenience.

“Open space” means any parcel or area of land or water not occupied by structures, hard surfacing, or other impervious surfaces (except pedestrian /bicycle paths) and which is set aside, designated, dedicated, or reserved for active or passive recreation, visual

enjoyment, or critical area buffering. Tidelands are not open space. Open space may be for either public or private use, or for the common use by the occupants of the development which includes the open space.

“Outdoor storage” means a land use providing long-term storage of vehicles and equipment.

“Performance standard” means a criterion regulating nuisance effects which a land use or activity shall not exceed.

“Permit” means a written permission issued by a government official authorizing the permittee to do that which is not illegal, but which is also not allowed without such authority.

“Pre-application conference” means an optional procedure wherein the applicant and TRC staff meet prior to the submittal of a development application. The purpose is to review the preliminary information for completeness and adequacy, consult with the TRC about the intent, standards, and provisions of any applicable regulations, and identify as many problems and opportunities as early as possible.

“Professional office” means a commercial land use providing space for professional or consulting services in law, architecture, engineering, finance, or any other service profession.

“Public facility” means a non-commercial use established for the benefit of the community in which it is located.

“Restaurant” means a commercial land use providing space for on-premises preparation, consumption, retail sales, and service of food and beverages, which may or may not include sale of alcohol.

“Retail food business” means a commercial land use providing space for sale of food and beverages, for off-premises consumption, which may or may not include sale of alcohol.

“Retail sales business” means a commercial land use providing space for purchase, stock, display, and sale of a wide variety of products.

“Right-of-way” means a parcel acquired by dedication or condemnation and intended to be occupied or occupied by a road, street, utility line, or other similar linear uses.

“Single family residence” means a residential unit permanently installed and served by infrastructure.

“Subdivision” means any improved or vacant land divided into two or more legal parcels for future development, lease, or sale. A major subdivision is one creating five or more parcels, while a minor subdivision or short plat is limited to a subdivision totaling four or fewer parcels.

“Tavern or retail liquor sales” means a commercial land use providing space for on-premises (for taverns) or carry-out (for retail stores) preparation, display, consumption, retail sales, and/or service of beer, wine, and/or liquor; according to the regulations of the Lummi Nation Code, Title 20.

“Temporary use” means a use established for a fixed time with the intent to discontinue the use upon expiration of the time period.

“Tideland” means the beach /tide flats area located between upland property and marine water bodies and defined by tidal reference levels; i.e., between ordinary high water mark (OHWM) and extreme low tide.

“Tribe” means the Lummi Indian Nation, its government, and its enrolled members, as represented by the Lummi Indian Business Council (LIBC).

“Warehousing and storage” means an industrial land use providing land for receiving, handling, storing, and shipping goods or produce, except bulk storage of flammable, explosive, or hazardous materials.

“Wholesale business” means a commercial land use providing space for receiving, storing, and shipping of goods for resale.

“Wildlife and game management” means a land use providing land for conservation, reclamation, and restoration of fish and

wildlife habitats.

“Wood products culture” means a forestry land use providing land for planning, growth, and management of marketable timber resources.

“Wood products processing” means a forestry

land use providing land for logging operations, including temporary sawmills.

“Wood products thinning” means a forestry land use intended to enhance and increase the amount of marketable timber in a management tract.

APPENDIX A

Number of owners	Land Use Permit	Conditional Use or Planned Development Permit	Variance or Zone Change	Subdivision
> 20	≥ 51%	≥67%	>75%	BIA Regulations
5-20	≥60%	≥75%	100%	BIA Regulations
<4	>75%	100%	100%	BIA Regulations

TITLE 15A LUMMI NATION CODE OF LAWS FLOOD DAMAGE PREVENTION CODE

Chapter 15A.01 Authorization, Finding of Fact, and Purpose

15A.01.010 Statutory Authorization

The Lummi Indian Business Council is delegated the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of the citizens of the Lummi Reservation. Therefore, the Lummi Indian Business Council does ordain as follows:

15A.01.020 Finding of Fact

(a) The flood hazard areas of the Lummi Indian Reservation are subject to periodic inundation that may result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, damages to treaty protected resources, and impairment of the tax base, all of which adversely affect the public health, safety, and general welfare.

(b) These flood losses are caused by the cumulative effect of winter storms and upstream land uses in the Nooksack River basin which increase flood heights and velocities, and when inadequately managed, damage uses in other areas. Uses that are inadequately floodproofed, elevated, or otherwise protected from flood damage also contribute to the flood loss.

15A.01.030 Statement of Purpose

It is the purpose of this ordinance to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas by provisions designed

- (a) to protect human life and health;
- (b) to minimize expenditure of public money and costly flood control projects;

(c) to minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;

(d) to minimize prolonged business interruptions;

(e) to minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets, and bridges located in areas of special flood hazard;

(f) to minimize damage to treaty protected resources;

(g) to help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future flood areas;

(h) to ensure that potential buyers are notified that property is in an area of special flood hazard; and,

(i) to ensure that those who occupy the areas of special flood hazard assume legal and financial responsibility for their actions.

15A.01.040 Methods of Reducing Flood Losses

In order to accomplish its purposes, this ordinance includes methods and provisions for

(a) restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities;

(b) requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;

(c) controlling the alteration of natural flood plains, stream channels, and natural protective barriers, which help accommodate or channel flood waters;

(d) controlling filling, grading, dredging, and other development which may increase flood

damage; and

(e) preventing or regulating the construction of flood barriers which will unnaturally divert flood waters or may increase flood hazards in other areas.

Chapter 15A.02 Definitions

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

15A.02.010 Appeal

Means a request for a review of the interpretation of any provision of this ordinance or a request for a variance.

15A.02.020 Area of Shallow Flooding

Means a designated AO, or AH Zone on the Flood Insurance Rate Map (FIRM). The base flood depths range from one to three feet; a clearly defined channel does not exist; the path of flooding is unpredictable and indeterminate; and, velocity flow may be evident. AO is characterized as sheet flow and AH indicates ponding.

15A.02.030 Area of Special Flood Hazard

Means the land in the flood plain within a community subject to a one percent or greater chance of flooding in any given year. Designation on maps always includes the letters A or V.

15A.02.040 Base Flood

Means the flood having a one percent chance of being equaled or exceeded in any given year. Also referred to as the "100-year flood." Designation on maps always includes the letters A or V.

15A.02.050 Basement

Means any area of the building having its floor subgrade (below ground level) on all sides.

15A.02.060 Breakaway Wall

Means a wall that is not part of the structural support of the building and is intended

through its design and construction to collapse under specific lateral loading forces, without causing damage to the elevated portion of the building or supporting foundation system.

15A.02.070 Coastal High Hazard Area

Means an area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. The area is designated on the FIRM as Zone V1-V30, VE or V.

15A.02.080 Critical Facility

Means a facility for which even a slight chance of flooding might be too great. Critical facilities include, but are not limited to, schools, nursing homes, hospitals police, fire and emergency response installations, and installations which produce, use, or store hazardous materials or hazardous waste.

15A.02.090 Development

Means any man-made change to improved or unimproved real estate, including but not limited to, buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations located within the area of special flood hazard.

15A.02.100 Elevated Building

Means for insurance purposes, a non-basement building which has its lowest elevated floor raised above ground level by foundation walls, shear walls, post, piers, pilings, or columns.

15A.02.110 Existing Manufactured Home Park or Subdivision

Means a manufactured home park subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before the effective date of the adopted floodplain management regulations.

15A.02.120 Expansion to an Existing Manufactured Home Park or Subdivision

Means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

15A.02.130 Flood or Flooding

Means a general and temporary condition of partial or complete inundation of normally dry land areas from

(a) the overflow of inland or tidal waters and/or

(b) the unusual and rapid accumulation of runoff of surface waters from any source.

15A.02.140 Flood Insurance Rate Map (Firm)

Means the official map on which the Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

15A.02.150 Flood Insurance Study

Means the official report provided by the Federal Insurance Administration that includes flood profiles, the Flood Boundary-Floodway Map, and the water surface elevation of the base flood.

15A.02.160 Floodway

Means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

15A.02.170 Lowest Floor

Means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage, in an area other than a basement area, is not considered a building's lowest floor, provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements

of this ordinance found at Section 15A.05.050(a)(2).

15A.02.180 Manufactured Home

Means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when attached to the required utilities. The term “manufactured home” does not include a “recreational vehicle.”

15A.02.190 Manufactured Home Park or Subdivision

Means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

15A.02.200 New Construction

Means structures for which the “start of construction” commenced on or after the effective date of this ordinance.

15A.02.210 New Manufactured Home Park or Subdivision

Means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of adopted floodplain management regulations.

15A.02.220 Recreational Vehicle

Means a vehicle which is

- (a) built on a single chassis;
- (b) 400 square feet or less when measured at the largest horizontal projection;
- (c) designed to be self-propelled or permanently towable by a light duty truck; and
- (d) designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

15A.02.230 Start of Construction

Includes substantial improvement, and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, placement or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation of the property or accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

15A.02.240 Structure

Means a walled and roofed building including a gas or liquid storage tank that is principally above ground.

15A.02.250 Substantial Damage

Means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

15A.02.260 Substantial Improvement

Means any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure either

- (a) before the improvement or repair is started; or
- (b) if the structure has been damaged and is being restored, before the damage occurred.

For the purposes of this definition “substantial improvement” is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure.

The term does not, however, include either

(c) any project for improvement of a structure to comply with existing state or local health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions, or

(d) any alteration of a structure listed on the National Register of Historic Places or a State Inventory of Historic Places.

15A.02.270 Variance

Means a grant of relief from the requirements of this ordinance which permits construction in a manner that would otherwise be prohibited by this ordinance.

15A.02.280 Water Dependent

Means a structure for commerce or industry which cannot exist in any other location and is dependent on the water by reason of the intrinsic nature of its operations.

Chapter 15A.03 General Provisions

15A.03.010 Land to Which this Ordinance Applies

This ordinance shall apply to all areas of special flood hazards within the exterior boundary of the Lummi Indian Reservation, including fee and trust land parcels.

15A.03.020 Basis for Establishing the Areas of Special Flood Hazard

A scientific and engineering report commissioned by the Federal Insurance Administration (FIA) shall identify the areas of special flood hazard. When the report is completed, along with accompanying flood insurance rate maps (FIRM), it shall be adopted and incorporated by reference into this ordinance. Future studies and flood insurance maps, as amended, shall become a part of this ordinance. The Flood Insurance

Study (FIS), when completed, shall be on file at the Lummi Nation Planning Department. Until the study is completed, the Lummi Nation Planning Department shall use the best information available, as outlined in Chapter 15A.04.031(b), to determine the special flood hazard areas and required elevations of structures, until a new FIRM is issued which incorporates the data utilized in Chapter 15A.04.031(b).

15A.03.030 Penalties for Non Compliance

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. Violations of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions), shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall upon conviction thereof be fined not more than \$1000.00, for each violation, and in addition shall pay all costs and expenses involved in the case. Nothing herein contained shall prevent the Lummi Indian Business Council from taking such other lawful action as is necessary to prevent or remedy any violation.

15A.03.040 Abrogation and Greater Restrictions

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and another ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

15A.03.050 Interpretation

In the interpretation and application of this ordinance, all provisions shall be

- (a) considered as minimum requirements;
- (b) liberally construed in favor of the governing body; and
- (c) deemed neither to limit or repeal any other powers granted under Lummi Nations laws

and federal statutes.

15A.03.060 Warning and Disclaimer of Liability

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur on rare occasions. Flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of Lummi Indian Business Council, any officer or employee thereof, or the Federal Insurance Administration, for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

Chapter 15A.04 Establishment of Development Permit

15A.04.010 Development Permit Required

A development permit shall be obtained before construction or development begins within any area of special flood hazard established in Chapter 15A.03.020. The permit shall be for all structures including manufactured homes, as set forth in the "DEFINITIONS," and for all development including fill and other activities, also as set forth in the "DEFINITIONS."

15A.04.020 Application for Development Permit

Application for a development permit shall be made on forms furnished by the Planning Department and may include but not be limited to plans in duplicate drawn to scale showing the nature, location, dimensions, and elevations of the area in question; existing or proposed structures, fill, storage of materials, drainage facilities, and the location of the foregoing. Specifically, the following information is required:

(a) Elevation in relation to mean sea level, of the lowest floor (including basement) of all structures;

(b) Elevation in relation to mean sea level to which any structure has been floodproofed;

(c) Certification by a registered professional engineer or architect that the floodproofing methods for any nonresidential structure meet the floodproofing criteria in Chapter 15A.05.050(b); and

(d) Description of the extent to which a watercourse will be altered or relocated as a result of proposed development.

15A.04.030 Designation of the Director of Planning Department

The Director of the Planning Department (Director) is hereby appointed to administer and implement this ordinance by granting or denying development permit applications in accordance with its provisions.

15A.04.031 Duties and Responsibilities of the Director

Duties of the Director shall include, but not be limited to:

(a) Permit Review.

(1) Review all development permits to determine that the permit requirements of this ordinance have been satisfied.

(2) Review all development permits to determine that all necessary permits have been obtained from those Federal, State, or local governmental agencies from which prior approval is required.

(3) Review all development permits to determine if the proposed development is located in the floodway. If located in the floodway, assure that the encroachment provisions of Chapter 15A.05.060(a) are met.

(b) Use of Other Base Flood Data

When base flood elevation data has not been provided in accordance with Chapter 15A.03.020, BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD, the Director shall obtain, review, and reasonably utilize any base flood

elevation and floodway data available from a Federal, State or other source, in order to administer Chapters 15A.05.050, SPECIFIC STANDARDS, and 15A.05.060 FLOODWAYS.

(c) Information to be Obtained and Maintained.

(1) Where base flood elevation data is provided through the Flood Insurance Study or required as in Section 15A.04.031(b), obtain and record the actual elevation (in relation to mean sea level) of the lowest floor (including basement) of all new or substantially improved structures, and whether or not the structure contains a basement.

(2) For all new or substantially improved floodproofed structures

(A) verify and record the actual elevation (in relation to mean sea level), and

(B) maintain the floodproofing certifications required in Section 15A.04.020(c).

(c) Maintain for public inspection all records pertaining to the provisions of this ordinance.

(d) Alteration of Watercourses.

(1) Provide the Director plans and application for watercourse alteration prior to any alteration or relocation of a watercourse, and submit evidence of Tribal approval to the Federal Insurance Administration.

(2) Require that maintenance is provided within the altered or relocated portion of said watercourse so that the flood carrying capacity is not diminished and fish and wildlife habitats are protected according to designs and mitigation plans jointly approved by the Director and by the Lummi Natural Resources Department.

(e) Interpretation of FIRM Boundaries.
Make interpretations where needed, as to exact location of the boundaries of the areas of special flood hazards (for example, where

there appears to be a conflict between a mapped boundary and actual field conditions). The person contesting the location of the boundary shall be given a reasonable opportunity to appeal the interpretation as provided in Section 15A.04.040.

15A.04.040 Appeal and Variance Procedure

(a) Appeal Board.

(1) The Lummi Planning Commission (Commission) as established by the Lummi Indian Business Council shall hear and decide appeals and requests for variances from the requirements of this ordinance.

(2) The Commission shall hear and decide appeals when it is alleged there is an error in any requirement, decision, or determination made by the Planning Department in the enforcement or administration of this ordinance.

(3) Those aggrieved by the decision of the Commission, or any landowner, may appeal such decision to the Lummi Indian Business Council, as provided in the Constitution of the Lummi Nation.

(4) In passing upon such applications, the Commission shall consider all technical evaluations, all relevant factors, standards specified in other sections of this ordinance, and

(A) the danger that materials may be swept onto other lands to the injury of others;

(B) the danger to life and property due to flooding or erosion damage;

(C) the susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;

(D) the importance of the services provided by the proposed facility to the community;

(E) the necessity to the facility of a

waterfront location, where applicable;

(F) the availability of alternative locations for the proposed use which are not subject to flooding or erosion damage;

(G) the compatibility of the proposed use with existing and anticipated development;

(H) the relationship of the proposed use to the comprehensive plan and flood plain management program for that area;

(I) the safety of access to the property in times of flood for ordinary and emergency vehicles;

(J) the expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;

(K) the costs of providing governmental services during and after flood conditions, including maintenance and repair of public utilities and facilities such as sewer, gas, electrical, and water systems, and streets and bridges;

(L) the potential adverse impacts to natural resources; and

(M) the potential adverse impacts to treaty protected resources.

(5) Upon consideration of the factors of Section 15A.04.040(a)(4) and the purposes of this ordinance, the Commission may attach such conditions to the granting of variances as it deems necessary to further the purposes of this ordinance.

(6) The Commission shall maintain the records of all appeal actions and report any variances to the Federal Insurance Administration upon request.

(b) Conditions for Variances

(1) Generally, the only condition under which a variance from the elevation standard may be issued is for new

construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing items (A-M) in Section 15A.04.040(a)(4) have been fully considered. As the lot size increases the technical justification required for issuing the variance increases.

(2) Variances may be issued for the reconstruction, rehabilitation, or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, or declared a historic place by the Lummi Nation, without regard to the procedures set forth in this section.

(3) Variances shall not be issued within a designated floodway if any increase in flood levels during the base flood discharge would result.

(4) Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

(5) Variances shall only be issued upon

(A) a showing of good and sufficient cause;

(B) a determination that failure to grant the variance would result in exceptional hardship to the applicant; and

(C) a determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public as identified in Section 15A.04.040(a)(4), or conflict with existing local laws or ordinances.

(6) Variances as interpreted in the National Flood Insurance Program are based on the general zoning law principle that they pertain to a physical piece of property; they are not personal in nature and do not pertain to the structure, its inhabitants, economic or financial circumstances. They primarily address small lots in densely

populated residential neighborhoods. As such, variances from the flood elevations should be quite rare.

(7) Variances may be issued for nonresidential buildings in very limited circumstances to allow a lesser degree of floodproofing than watertight or dry-floodproofing, where it can be determined that such action will have low damage potential, complies with all other variance criteria except 15A.04.040(b)(1), and otherwise complies with Sections 15A.05.010(a) and 15A.05.010(b) of the GENERAL STANDARDS.

(8) Any applicant to whom a variance is granted shall be given written notice that the structure will be permitted to be built with a lowest floor elevation below the base flood elevation and that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation.

Chapter 15A.05 Provisions For Flood Hazard Reduction

15A.05.010 General Standards

In all areas of special flood hazards, the following standards are required:

(a) Anchoring

(1) All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure.

(2) All manufactured homes must likewise be anchored to prevent flotation, collapse, or lateral movement, and shall be installed using methods and practices that minimize flood damage. Anchoring methods may include, but are not limited to, use of over-the-top or frame ties to ground anchors (Reference FEMA's "Manufactured Home Installation in Flood Hazard Areas" guidebook for additional techniques).

(b) Construction Materials and Methods

(1) All new construction and substantial

improvements shall be constructed with materials and utility equipment resistant to flood damage.

(2) All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage.

(3) Electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities shall be designed and/or otherwise elevated or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

(c) Utilities

(1) All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

(2) New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharge from the systems into flood waters.

(3) On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

(d) Subdivision Proposals

(1) All subdivision proposals shall be consistent with the need to minimize flood damage;

(2) All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage;

(3) All subdivision proposals shall have adequate drainage provided to reduce exposure to flood damage; and

(4) Where base flood elevation data has not been provided or is not available from another authoritative source, it shall be generated for subdivision proposals and other proposed developments which

contain at least 50 lots or 5 acres (whichever is less).

(e) Review of Building Permits.

Where elevation data is not available either through the Flood Insurance Study or from another authoritative source Section 15A.04.031(b), Applications for building permits shall be reviewed to assure that proposed construction will be reasonably safe from flooding. The test of reasonableness is a local judgment and includes use of historical data, high water marks, photographs of past flooding, etc., where available. Failure to elevate at least two feet above grade in these zones may result in higher insurance rates.

15A.05.050 Specific Standards

In all areas of special flood hazards where base flood elevation data has been provided as set forth in Section 15A.03.020, BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD or Section 15A.04.031, Use of Other Base Flood Data, the following provisions are required:

(a) Residential Construction

(1) New construction and substantial improvement of any residential structure shall have the lowest floor, including basement, elevated one foot above the base flood elevation.

(2) Fully enclosed areas below the lowest floor that are subject to flooding are prohibited, or shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following minimum criteria:

(A) A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall provided.

(B) The bottom of all openings shall be no higher than one foot above grade.

(C) Openings may be equipped with screens, louvers, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

(b) Nonresidential Construction

New construction and substantial improvement of any commercial, industrial or other nonresidential structure shall either have the lowest floor, including basement, elevated one foot above the base flood elevation; or, together with attendant utility and sanitary facilities, shall

(1) be floodproofed so that below one foot above the base flood level the structure is watertight with walls substantially impermeable to the passage of water;

(2) have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy;

(3) be certified by a registered professional engineer or architect that the design and methods of construction are in accordance with accepted standards of practice for meeting provisions of this subsection based on their development and/or review of the structural design, specifications and plans. Such certifications shall be provided to the official as set forth in Section 15A.04.031(c)(2);

(4) nonresidential structures that are elevated, not floodproofed, must meet the same standards for space below the lowest floor as described in 15A.05.050(a)(2);

(5) applicants floodproofing nonresidential buildings shall be notified that flood insurance premiums will be based on rates that are one foot below the floodproofed level (e.g., a building floodproofed to the base flood level will be rated as one foot below).

(d) Manufactured Homes.

(1) All manufactured homes to be placed or substantially improved within Zones A1-A30, AH, and AE on the community's FIRM on sites

(A) outside of a manufactured home park or subdivision,

(B) in a new manufactured home park or subdivision,

(C) in an expansion to an existing manufactured home park or subdivision, or

(D) in an existing manufactured home park or subdivision on which a manufactured home has incurred "substantial damage" as the result of a flood; shall be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated one foot above the base flood elevation and be securely anchored to an adequately anchored foundation system to resist flotation collapse and lateral movement.

(2) Manufactured homes to be placed or substantially improved on sites in an existing manufactured home park or subdivision within Zones A1-30, AH, and AE on the community's FIRM that are not subject to the above manufactured home provisions shall be elevated so that either

(A) the lowest floor of the manufactured home is elevated one foot above the base flood elevation, or

(B) the manufactured home chassis is supported by reinforced piers or other foundation elements of at least equivalent strength that are no less than 36 inches in height above grade and be securely anchored to an adequately anchored foundation system to resist flotation, collapse, and lateral movement. At a minimum a "reinforced pier" would have a footing adequate to support the weight of the manufactured home under saturated soil conditions such as occur during a flood. In addition, if stacked concrete blocks are used, vertical steel reinforcing rods should be placed in the hollows of the blocks and those hollows filled with concrete or high strength mortar. In areas subject to high velocity

floodwaters and debris impact, cast-in-place reinforced concrete piers may be appropriate.

(e) Recreational Vehicles.

Recreational vehicles placed on sites within Zones A1-30, AH, and AE on the community's FIRM shall

(1) be on the site for fewer than 180 consecutive days and fully licensed and ready for highway use, on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions; or

(2) meet the requirements of 15A.05.050(d) above and the elevation and anchoring requirements for manufactured homes.

15A.05.060 Floodways

Located within areas of special flood hazard established in Section 15A.03.020 are areas designated as floodways. Since the floodway is an extremely hazardous area due to the velocity of flood waters which carry debris, potential projectiles, and erosion potential, the following provisions apply:

(a) Prohibit encroachments, including fill, new construction, substantial improvements, and other development unless certification by a registered professional engineer or architect is provided demonstrating that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge.

(b) Construction or reconstruction of residential structures is prohibited within designated floodways, except for

(1) repairs, reconstruction, or improvements to a structure which do not increase the ground floor area; and

(2) repairs, reconstruction or improvements to a structure, the cost of which does not exceed 50 percent of the market value of the structure either

(A) before the repair or reconstruction is started, or

(B) if the structure has been damaged, and is being restored, before the damage occurred. Work done on structures to comply with existing health, sanitary, or safety codes or to structures identified as historic places shall not be included in the 50 percent.

(c) If Section 15A.05.060(a) is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Section 15A.05, PROVISIONS FOR FLOOD HAZARD REDUCTION.

15A.05.070 Encroachments

The cumulative effect of any proposed development, where combined with all other existing and anticipated development, shall not increase the water surface elevation of the base flood more than one foot at any point.

15A.05.080 Standards For Shallow Flooding Areas (AO Zones)

Shallow flooding areas appear on FIRMs as AO zones with depth designations. The base flood depths in these zones range from 1 to 3 feet above ground where a clearly defined channel does not exist, or where the path of flooding is unpredictable and where velocity flow may be evident. Such flooding is usually characterized as sheet flow. In these areas, the following provisions apply:

(a) New construction and substantial improvements of residential structures and manufactured homes within AO zones shall have the lowest floor (including basement) elevated above the highest grade adjacent to the building, one foot or more above the depth number specified on the FIRM (at least two feet if no depth number is specified).

(b) New construction and substantial improvements of nonresidential structures within AO zones shall either

(1) have the lowest floor (including basement) elevated above the highest adjacent grade of the building site, one foot

or more above the depth number specified on the FIRM (at least two feet if no depth number is specified); or

(2) together with attendant utility and sanitary facilities, be completely flood proofed to or above that level so that any space below that level is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. If this method is used, compliance shall be certified by a registered professional engineer or architect as in section 15A.05.050(b)(3).

(c) Require adequate drainage paths around structures on slopes to guide floodwaters around and away from proposed structures.

(d) Recreational vehicles placed on sites within AO Zones on the community's FIRM shall

(1) be on the site for fewer than 180 consecutive days and be fully licensed and ready for highway use on its wheels or jacking system; be attached to the site only by quick disconnect type utilities and security devices; and have no permanently attached additions; or

(2) meet the requirements of 15A.05.080 above and the elevation and anchoring requirements for manufactured homes.

15A.05.090 Coastal High Hazard Areas

Located within areas of special flood hazard established in Section 15A.03.020 are Coastal High Hazard Areas, designated as Zones V1-V30, VE and/or V. These areas have special flood hazards associated with high velocity waters from surges and, therefore, in addition to meeting all provisions in this ordinance, the following provisions shall also apply:

(a) All new construction and substantial improvements in Zones V1-V30 and VE (V if base flood elevation data is available) shall be elevated on pilings and columns so that

(1) the bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated one foot or more above the base flood level; and

(2) the pile or column foundation and structure attached thereto is anchored to resist flotation, collapse and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one percent chance of being equaled or exceeded in any given year (100-year mean recurrence interval).

(b) A registered professional engineer or architect shall develop or review the structural design, specifications and plans for the construction, and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of (1) and (2) of this Section.

(c) Obtain the elevation (in relation to mean sea level) of the bottom of the lowest structural member of the lowest floor (excluding pilings and columns) of all new and substantially improved structures in Zones V1-30 and VE, and whether or not such structures contain a basement. The local administrator shall maintain a record of all such information.

(d) All new construction shall be located landward of the reach of ordinary high water.

(e) Provide that all new construction and substantial improvements have the space below the lowest floor either free of obstruction or constructed with non-supporting breakaway walls, open wood lattice-work, or insect screening intended to collapse under wind and water loads without causing collapse, displacement, or other structural damage to the elevated portion of the building or supporting foundation system. For the purpose of this section, a breakaway wall shall have a design safe loading resistance of not less than 10 and no more than 20 pounds per square foot. Use of breakaway walls which exceed a design safe loading

resistance of 20 pounds per square foot (either by design or when so required by local or State codes) may be permitted only if a registered professional engineer or architect certifies that the designs proposed meet the following conditions:

(1) Breakaway wall collapse shall result from water load less than that which would occur during the base flood; and

(2) The elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement, or other structural damage due to the effects wind and water loads acting simultaneously on all building components (structural and nonstructural). Maximum wind and water loading values to be used in this determination shall each have a one percent chance of being equaled or exceeded in any given year (100-year mean recurrence interval).

(f) If breakaway walls are utilized, such enclosed space shall be useable solely for parking of vehicles, building access, or storage. Such space shall not be used for human habitation.

(g) Prohibit the use of fill for structural support of buildings.

(h) Prohibit man-made alteration of sand dunes which would increase potential flood damage.

(i) All manufactured homes to be placed or substantially improved within Zones V1-V30, V, and VE on the community's FIRM on sites

(1) outside of a manufactured home park or subdivision,

(2) in a new manufactured home park or subdivision,

(3) in an expansion to an existing manufactured home park or subdivision, or

(4) in an existing manufactured home park or subdivision on which a manufactured home has incurred "substantial damage" as the result of a flood shall meet the

standards of paragraphs 15A.05.090(a) through (h) of this section and that manufactured homes placed or substantially improved on other sites in an existing manufactured home park or subdivision within Zones V1-30, V, and VE on the FIRM meet the requirements of Section 15A.05.050(d).

(j) Recreational vehicles placed on sites within Zones V1-30, V, and VE on the community's FIRM either

(1) be on the site for fewer than 180 consecutive days and be fully licensed and ready for highway use on its wheels or jacking system; be attached to the site only by quick disconnect type utilities and security devices; and have no permanently attached additions; or

(2) Meet the requirements of Section 15A.04.010 (Permitting requirements) and paragraphs 15A.05.090(a) through (h) of this section.

15A.05.100 Critical Facility

Construction of new critical facilities shall be, to the extent possible, located outside the limits of the Special Flood Hazard Area (SFHA) (100-year floodplain). Construction of new critical facilities shall be permissible within the SFHA if no feasible alternative site is available. Critical facilities constructed within the SFHA shall have the lowest floor elevated three feet or more above the level of the base flood elevation (100-year) at the site. Floodproofing and sealing measures must be taken to ensure that toxic substances will not be displaced by or released into flood waters. Access routes elevated to or above the level of the base flood elevation shall be provided to all critical facilities to the extent possible.

Title15pub04

CERTIFICATION

I, Al Scott Johnson, Chairman of the Lummi Law and Justice Commission have reviewed this document as required by law, and I certify that this is a true and correct copy of Title 15A, that it was duly enacted by the Lummi Indian Business Council on the 16th day of September, 1998 and approved by the General Council on the 26th day of August, 1998 and is the duly enacted and certified law of the Lummi Nation.

Dated this 14 day of September, 1998.

Al Scott Johnson
Chairman of the Law and Justice Commission of the Lummi
Nation

Appendix E:
Summary of Lummi Nation Flood Policies

FLOOD-MITIGATION POLICIES OF THE LUMMI NATION

Policies recommended to direct the floodplain, coastal, and watershed-management activities of the Lummi Nation are listed in this appendix. Adoption of the FDRP by the LIBC (Resolution # 2001-131) certifies that these policies have been adopted by the LIBC. These policies provide a set of operating principles to guide flood-hazard-reduction efforts over the long term. The policies are divided into seven categories: general policies; floodplain land use; watershed management; flood-hazard-reduction projects; river-channel maintenance; flood warning, information, and education; and emergency response. These categories and much of the text were incorporated or adapted from the Tillamook County Flood Hazard Mitigation Plan (Tillamook County 1996).

GENERAL POLICIES

The general policies listed below form a mission statement for the FDRP, providing general guidance for all future activities. All other policies and recommendations in this plan are designed to fulfill one or more of these general policies.

National Flood Insurance Program (NFIP)

Policy G-1:

In order to better protect public health and safety and to achieve discounts of flood-insurance premiums by qualifying for the CRS Program, the Lummi Nation should not only meet, but also exceed where practicable, the federal minimum standards for NFIP qualification.

Restricting New Development in Hazardous Areas

Policy G-2:

New subdivisions, new residential and commercial development, and substantial improvement of commercial and residential structures should be discouraged (if not already prohibited by Title 15A FDPC) on lands identified as a floodway or a coastal velocity zone. Title 15A restrictions must be enforced.

Policy G-3:

Development may be allowed in areas of lesser flood hazard in identified floodplains (i.e., the flood fringe) or in coastal flooding areas only if it can be built to withstand flooding without suffering significant damage. Title 15A restrictions must be enforced.

Reducing Flood Impacts to Existing Developments

Policy G-4:

The Lummi Nation should seek to reduce the risk of severe flood hazards and damages experienced by existing public and private developments.

Policy G-5:

New development or other actions should not be allowed to increase flood risks to existing properties and development.

Reducing Long-Term Public Costs

Policy G-6:

Where possible, flood-hazard-reduction projects should be selected, designed, and implemented to be permanent or low-maintenance solutions to flood problems.

Protecting Natural Resources and Functions

Policy G-7:

The existing flood storage, conveyance functions, and ecological values of floodplains, wetlands, and riparian corridors should be protected and, where possible, enhanced or restored.

Multi-Objective Management of Water Resources

Policy G-8:

Floodplains, rivers, streams, coastal areas, and other water resources should be managed for multiple uses, including flood- and erosion-hazard reduction, fish and wildlife habitat, fish harvesting, agriculture, open space, recreation, and, where appropriate, water supply.

Planning with a Watershed Perspective

Policy G-9:

Flood-damage-reduction plans and projects should be developed in a basin-wide context using watershed councils or similar inter-governmental commissions, recognizing that the watershed and drainage network function as an interdependent system.

Intergovernmental Coordination and Cooperation

Policy G-10:

The Lummi Nation's floodplain- and watershed-management activities should be planned and implemented in cooperation with cities, counties and other agencies sharing jurisdiction in the Nooksack River basin, consistent with co-management responsibilities of tribes and tribal treaty rights. The Lummi Nation should also closely review the management plans and activities of other jurisdictions.

Assessment of Flood Problems and Mitigation Alternatives

Policy G-11:

Solutions to flood problems should be derived from a science-based assessment of flood problems and potential mitigation alternatives.

FLOODPLAIN LAND-USE POLICIES

Future-Conditions Floodplain

Policy FP-1:

Wherever future-condition flows have been modeled and adopted as part of a basin plan, they should be used to define the 100-year flood of record and future-conditions floodplain (i.e., the 100-year floodplain expected under build-out of current land-use plans and regulations for the basin). In the Nooksack River basin and coastal flood areas, land-use policies and flood-hazard regulations should apply to the 100-year future-conditions floodplain.

Development in the FEMA Floodway

Policy FP-2:

The current floodway standards, contained in the Lummi Nation Title 15A FDPC, should be maintained and consistently enforced. These standards prohibit new residential structures. New commercial development in a floodway should be avoided unless it is the only practicable alternative.

Development in FEMA Coastal High Hazard Areas (Velocity Zones)

Policy FP-3:

The current standards for coastal high hazard areas, contained in the Lummi Nation Title 15A FDPC, should be maintained and consistently enforced. New commercial development should be avoided unless it is the only practicable alternative.

Construction Standards for Flood Protection

Policy FP-4:

New development and substantial improvements in the floodplain should be constructed so that they can withstand the 100-year flood without sustaining significant damage. They should be built so that the lowest finished floor is one foot above the projected 100-year flood within the designated 100-year flood fringe. Areas below the lowest finished floor of residential structures should be designed to allow for the entry and exit of floodwaters.

Floodplain Land Uses

Policy FP-5:

In areas designated for agriculture or “rural residential” use in the Lummi Nation General Land-Use Plan (GLUP), land uses which preserve the natural flood storage and conveyance functions of the floodplain – such as agriculture, open space, fish and wildlife habitat, and recreation – are preferred within the floodplain.

Policy FP-6:

Critical facilities and land uses that represent special risks (e.g., hazardous waste storage facilities, hospitals, schools, nursing homes, and police and fire stations) should not be built in the floodplain or coastal flood zones unless no reasonable alternative is available. If located in the floodplain, these facilities and the access routes needed for their operation should be built in a manner that protects public health and safety during at least the 100-year flood. In addition, special measures should be taken to ensure that hazardous or toxic substances are not released into floodwaters.

Migrating Rivers

Policy FP-7:

Channel-migration hazard areas should be identified through geomorphologic analyses and review of historic channel-migration patterns and rates. Land-use regulations should be adopted and applied in order to preclude unsafe development in these areas.

Reducing Flood Impacts on Agriculture - Cow Pads and Manure Lagoons

Policy FP-8:

The construction of elevated cow pads is encouraged as a means to protect livestock on farms that are subject to significant flooding.

Policy FP-9:

If manure lagoons associated with concentrated animal feeding operations are located in the flood plain, they must be flood-proofed

WATERSHED-MANAGEMENT POLICIES

Impacts of Basin-wide Land Uses on Flooding

Policy WM-1:

The Lummi Nation should participate in the development of watershed analysis and comprehensive basin plans for the Nooksack River watershed (as in the Water Resource Inventory Area 1 [WRIA 1] Watershed Management Project) to ensure that the best available science is used to support decisions on natural resource management.

Policy WM-2:

Basin plans should estimate the downstream effects of increased runoff rates and/or volumes caused by clearing and development of upstream lands.

Policy WM-3:

Where downstream impacts will result from increased runoff rates and volumes, new upland land uses should be required to either control runoff rates and volumes or to apply other equally effective measures to protect downstream properties.

FLOOD-HAZARD-REDUCTION PROJECT POLICIES

Flood-Hazard Problems

Policy FHR-1:

The following types of properties and problems are eligible for protection:

- (1) Properties where there is an imminent threat to public health or safety;
- (2) Usual and accustomed (U & A) grounds and stations for which the Lummi Nation has treaty rights to hunt, fish, and gather;
- (3) Cultural resources;
- (4) Lummi Nation capital improvements (e.g., water-treatment plants, wastewater-treatment plants, roads, fish hatcheries, and buildings);
- (5) The Lummi Nation has a written maintenance agreement or other legal obligation to protect the site;
- (6) A Lummi Nation action caused or contributed to the problem;
- (7) Other public property (such as a road, bridge, or park); and
- (8) Private homes, businesses, or agricultural uses vulnerable to severe damage.

Problem Prioritization

Policy FHR-2:

In determining the priority of a problem, the following factors should be taken into consideration: consequences, urgency, responsibility, and opportunity. These factors are described below.

Consequences:

The primary factor that determines the priority of a problem is the consequences that would result if a project is not implemented. Consequences should generally be prioritized in the following order:

- (1) Threats to public health and safety. Threats to public health and safety include threats to critical facilities (e.g., hospitals, schools, nursing homes, and emergency response facilities) and/or health-related infrastructures (e.g., water supply systems, sewer lines). The presence of deep, high velocity flows carrying debris through populated areas also constitutes a threat to life and limb.

- (2) Damage to public infrastructure and developed public property. Public infrastructure and developed public property includes, but is not limited to, roads, bridges, utility systems, public buildings, and fish hatcheries.
- (3) Damage to private structures. Private residential structures should receive higher priority than non-residential structures.
- (4) Damage to significant natural resources. Significant natural resources include fish and wildlife species and habitats that are considered regionally significant.
- (5) Damage to undeveloped public land. Undeveloped public land refers to both publicly-owned open space and land for which development rights have been purchased, such as agricultural land.

Urgency:

Urgency is a measure of how quickly action needs to be taken in order to prevent a problem from growing worse and requiring an increasingly costly solution. For example, the magnitude of an erosion-related problem will generally increase over time if not addressed. In comparing problems where equal consequences would result if action is not taken, the most urgent problem should be addressed first.

Responsibility:

Another important factor is whether the problem is related to a facility that the Lummi Nation has a legal commitment to maintain. In comparing problem sites with comparable consequences and urgency, those associated with facilities that the Lummi Nation has a legal commitment to maintain should be a higher priority than sites where no such commitment exists.

Opportunity:

Although consequences, urgency, and responsibility are the primary factors in determining problem priorities, projects can sometimes present opportunities for meeting multiple objectives. Examples include projects that enhance ecological resources, provide public access to the river system or coastal areas, and/or provide opportunities to cooperate with private landowners or other jurisdictions in funding and implementation of a project. The prioritization procedures should allow flexibility to give higher priority to projects that meet multiple objectives.

Modifications to Problem-Prioritization Criteria

Policy FHR-3:

Basin-specific modifications to the Problem Prioritization Policy (Policy FHR-2) may be made in accordance with the recommendations of an adopted basin plan and the approval of the Lummi Nation Natural Resources Department Director and the Lummi Nation Planning Department Director.

Alternative Evaluation and Selection

Policy FHR-4:

Project alternatives shall be evaluated according to the following criteria:

- (1) Risks to life and public health. The effect of the project on public health and safety shall be evaluated both upstream and downstream of the site. The project must have a beneficial or negligible impact on public health and safety.
- (2) Benefits versus costs. Benefits are measured as the effect on flood damages over the entire river or coastal system; costs are measured as public and private costs for implementing and maintaining the solution over the long term. Flood-damage-reduction benefits over the entire river or coastal system should exceed long-term costs.
- (3) Environmental impacts. The environmental impacts of the project include its effect on fish and wildlife habitat, wetlands, water quality, and other elements of the natural and human environment protected by federal and tribal laws. Impacts should be evaluated both upstream and downstream of the project site. The net environmental impacts of the project (plus any mitigation measures) over the long term should be positive or negligible.
- (4) Consistency with applicable land-use plans and regulations. The project should be consistent with land-use plans for the area and should not conflict with regulations governing activities in the floodplain, riparian corridor (e.g., stream or wetland buffers), or coastal zone unless the benefits of the project justify seeking an exception from applicable regulations.

Voluntary Acquisition versus Condemnation

Policy FHR-5:

Except under very limited circumstances, public acquisition of threatened buildings should be voluntary on the part of the property owner. Condemnation should be considered only under the following circumstances: (1) federal and/or tribal regulations prohibit reconstruction of the building; (2) the property in question is causing significant flood damage to other properties; (3) a property owner refuses to sell a portion of an area in which the majority of property owners have agreed to sell to the Lummi Nation; or (4) a property owner refuses to sell an area needed to complete an approved flood-hazard-reduction project.

Relocation or Acquisition Prioritization

Policy FHR-6:

In addition to the criteria listed in FHR-2 and FHR-4, flood-prone private structures should be prioritized for relocation or acquisition in the following order: (1) structures with unrepaired damage from a recent flood; (2) structures with the greatest potential for future flood damage; (3) structures with repaired damage from a past flood; and (4)

structures for which relocation or acquisition would provide the greatest public or natural resource benefit.

Using Land Created by Relocation or Acquisition

Policy FHR-7:

Open land created by the relocation or acquisition of structures should become either a tribal easement (if the structure is relocated to another site on the same lot) or be owned, managed, and retained by the Lummi Nation as an agricultural land, open space, riparian corridor, wetland area, recreation area, or some other similar use that is compatible with periodic flooding.

Level of Protection

Policy FHR-8:

New flood-hazard-reduction projects, whether protecting new or existing development, should seek to provide protection from the 100-year, future conditions flood, plus a margin of safety. When new projects are being built to protect existing development, lesser protection may be provided where 100-year protection is not practical or cost effective. Existing flood-hazard-reduction projects protecting existing developments should be maintained at their current level of protection unless the alternatives evaluation shows that a different level of protection is warranted or that maintenance of the existing project is not cost effective.

Multi-Objective Flood-Hazard-Reduction Projects

Policy FHR-9:

The Lummi Nation should, wherever practicable, design (on-Reservation) and encourage (off-Reservation) flood-hazard-reduction projects to include preservation or reestablishment of wetlands and other habitats for fish and wildlife and to be compatible with open space and recreation opportunities.

Designing for Low Maintenance

Policy FHR-10:

The Lummi Nation should, wherever possible, design and encourage projects in ways that require minimal or no maintenance over the long term. Levees and bank stabilization projects should include, where possible, toe rock, setback areas, vegetated stream banks, gentle riverward slopes, and materials and placement methods that provide long-term stability to the interior and face of the project.

Applying Standards of the Lummi Nation to Nontribal Projects

Policy FHR-11:

If another agency seeks the participation of the Lummi Nation in developing a flood-hazard-reduction project, the Lummi Nation should work with the lead agency to

incorporate Lummi flood-hazard-reduction policies and standards into the project. The Lummi Nation should not act as a sponsor for a flood-hazard-reduction project unless the project is consistent with or exceeds tribal flood-hazard-reduction policies and standards.

Alternatives to Maintenance

Policy FHR-12:

The Lummi Nation should evaluate alternatives to returning an existing project to its pre-damage condition when the original design appears to (1) contribute to high maintenance costs; (2) provide inadequate protection from flooding and erosion hazards; (3) transfer problems to other sites; (4) degrade aquatic or riparian habitat; (5) experience repetitive flood damage and repair costs; or (6) prevent an opportunity for habitat enhancement. This evaluation should occur on an ongoing basis. Alternative recommendations should be incorporated into the maintenance and/or project priorities of the responsible jurisdiction or agency. This policy is not intended to prevent emergency repairs necessary to address extreme threats to public health and safety.

Maintenance Program versus New Project

Policy FHR-13:

Any project that significantly changes the cross-section geometry or length of an existing flood- or erosion-control facility should be considered a new project, and should be analyzed, prioritized, and implemented as such. Projects that do not significantly change the cross-section geometry or length of an existing facility should be implemented as part of a maintenance program.

Public Access to Tribally Funded Projects

Policy FHR-14:

Tribal members should be granted access to new flood-hazard-reduction projects built with tribal funds. This access should be limited to passive uses such as fishing and hiking, which do not require any additional right-of-way or design modifications to the project and which will not increase the risk of structural damage to the facility.

Transportation Corridors for Bypassing Floods

Policy FHR-15:

Road projects that alleviate or mitigate the serious threat to public health and safety caused by flood closures should receive the highest priority for federal, tribal, state, and local funding.

RIVER-CHANNEL-MAINTENANCE POLICIES

Logjam Removal

Policy RCM-1:

Accumulations of large woody debris should be removed or dislodged only if they pose a direct threat to properties eligible for protection under Policy FHR-1 and can be removed without endangering personnel or equipment. Logjam removal should be prioritized along with other project needs according to the criteria in Policy FHR-2. Logjams that do not pose a direct threat to eligible properties should not be disturbed.

Policy RCM-2:

If large woody debris must be moved, it should either be dislodged so it can continue down through the system or removed and put back into the system at the next available downstream location. If it is not practical or reasonable to return the materials to the channel, they should, if possible, be incorporated into the riparian corridor adjacent to the river channel. When woody debris is placed in the river channel or corridor, its placement should not create new direct threats to other properties.

Dredging

Policy RCM-3:

Gravels may be removed from river and stream channels only if their presence poses a demonstrated direct threat to properties eligible for protection under Policy FHR-1 and only where such activity is determined to be the best flood-damage and erosion-reduction alternative available (using the criteria in Policy FHR-3). Dredging should be prioritized along with other project needs according to the criteria in Policy FHR-2. A basin-wide sediment budget, geomorphologic analysis, flood-simulation computer model, and associated Environmental Impact Statement and Biological Assessment should guide decisions related to dredging activity.

FLOOD WARNING, INFORMATION, AND EDUCATION POLICIES

Public Awareness of Flood Hazards

Policy E-1:

The Lummi Nation should make the following information available to current and prospective residents and landowners in flood-hazard areas: (1) the known flood risks of their property and the associated threats to their safety; (2) steps they can take to protect themselves and their belongings from flood damage; (3) regulations affecting floodplain-development activities; and (4) types of disaster assistance available. This information should be provided in advance of flood emergencies, during the emergency itself (through the Lummi Nation Law and Order Department and the Whatcom County Emergency Management Division), and after the emergency has passed.

Technical Coordination with Other Jurisdictions

Policy E-2:

The Lummi Nation should coordinate with governmental agencies that share jurisdiction of the Nooksack River basin to develop and adopt floodplain policies, regulations, and standards that are consistent with those of the Lummi Nation.

Sharing Information with Other Jurisdictions and the Public

Policy E-3:

The Lummi Nation should provide other governments and the public with accurate, clearly presented information that helps provide an understanding of flood management recommendations and decisions.

Flood Warnings

Policy E-4:

The Lummi Nation Law and Order Department should maintain and review coordination with existing emergency public-warning systems as well as methods for making such warnings available to the public on the Reservation.

EMERGENCY-RESPONSE POLICIES FOR FLOODS

The Lummi Nation's Role in Responding to Flood Emergencies

Policy ER-1:

Whatcom County is the lead jurisdiction in managing and coordinating emergency public health, safety, and welfare services before, during, and after flood emergencies within the county, off the Reservation. The Lummi Indian Business Council (LIBC) is responsible for flood-management services on the Reservation. The LIBC should coordinate flood-management planning with the River and Flood Division of the Whatcom County Public Works Department and emergency preparedness and response with the Whatcom County Sheriff's Office. The LIBC should also coordinate with the U.S. Army Corps of Engineers, the Federal Emergency Management Agency (FEMA), and other agencies and jurisdictions that have a role in responding to flood emergencies.

Sandbag Distribution

Policy ER-2:

The LIBC should provide a limited supply of sand and sandbags for private property owners during flood emergencies. Citizens should be responsible for requesting, picking up, filling, and placing sandbags, as well as cleaning up sandbags and sand on their property after floods. Sandbags should be placed as close as possible to the foundation of the structure being protected.